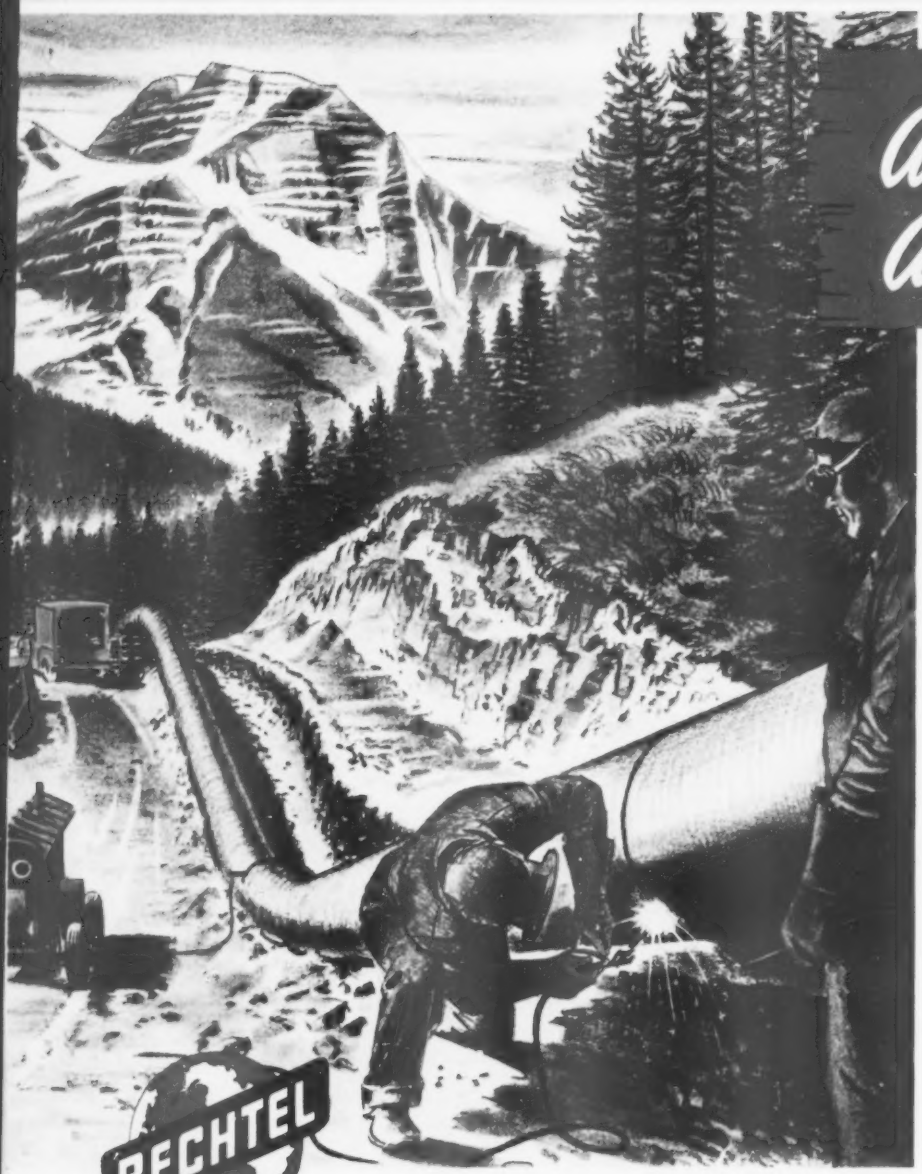
the PIPE-LINE NUMBER
. . . Two Insert Maps on Nation's Pipe Lines

OIL AND GAS JOURNAL



In British Columbia and the Pacific Northwest, October 15 is a red letter day. For that date—3 months ahead of schedule—marks completion of the TRANS MOUNTAIN OIL PIPE LINE, its first direct link with a major oil producing area. Together with the expansion of regional refining facilities, TRANS MOUNTAIN already is giving tremendous impetus to industrial development.

This 718-mile oil artery across the Rocky Mountains from Edmonton, Alberta, to Vancouver, British Columbia, opens with a capacity of 120,000 barrels per day. Early in 1954 its capacity will be increased to 150,000 b.p.d. and ultimately to more than 300,000—anticipating the growth of the great Evergreen Empire.

TRANS MOUNTAIN was designed and built under the engineering management of Canadian Bechtel Limited, Agent for the owner, Trans Mountain Oil Pipe Line Company.

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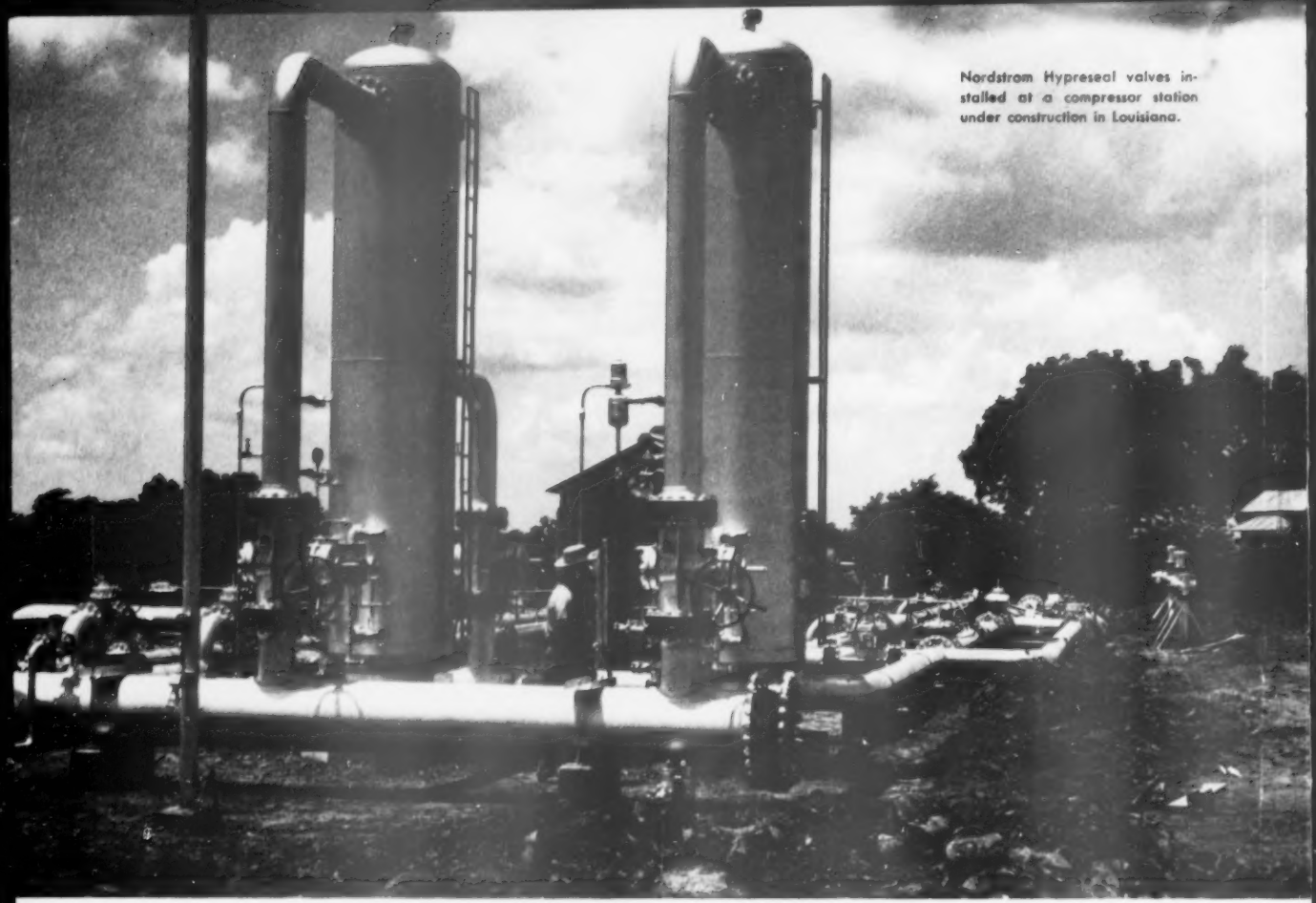

Nordstrom Hypreseal valves installed at a compressor station under construction in Louisiana.

ELIMINATE VALVE PROBLEMS

—Before They Begin . . .

. . . Install **Nordstroms** While Your Station is Under Construction

There won't be any valve problems at this pipe line compressor station—they're installing Nordstrom *Lubricant-Sealed* valves.

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They operate more easily because *lubricant* keeps the plug ready to slide smoothly within the body . . .

They last longer because *lubricant* prevents abrasion from wearing away the seating surfaces . . .

All of these advantages in one valve make Nordstroms first choice for pipe line services. Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania. *Canadian Licensee: Peacock Brothers Limited.*

ROCKWELL Built
Nordstrom Valves
Lubricant-Sealed for Positive Shut-Off

Another Rockwell Product

the OIL AND GAS JOURNAL

SEPTEMBER 21, 1953 VOL. 52 NO. 20

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In Brief . . .

1. WORLD'S DEEPEST CROSSING . . . Mackinac Straits crossing of Lakehead Pipe Line Co. invoived pulling of two 20,000-ft. lines, 20 in. in diameter. Line is laid across straits between two capes in area where Lake Huron and Lake Michigan join. At some points pipe was laid in 240 ft. of water.

2. ASSURED CROSSING SERVICE . . . Three types of crossings were used for the Texas Illinois gas line: (1) Multiple-line submerged crossings; (2) heavy-wall single-line submerged crossings; and (3) suspended crossings.

3. CROSSING LOWERED . . . Transcontinental Gas Pipe Line Corp's Hudson River crossing at 134th Street in New York City has been lowered an additional 12 ft. throughout its 2,400-ft. length. Gas service went on through the line uninterrupted during the lowering operation.

4. BETTER CROSSING PRACTICE . . . Crossings on Sinclair's Cushing-Chicago crude line were designed according to these specifications: (1) Lines are buried deeper than formerly; (2) pipe was laid with upstream bow in swift, turbulent rivers; (3) sags are located well back into the banks; (4) major crossings were built of electric weld pipe with ½-in. wall; (5) both wrapping and cathodic protection procedures were used; and (6) lighter river clamps, more closely spaced, were used.

5. HOT TAP CROSSOVER . . . Two 20-in. crossover lines, one on each shore of the Gulf of Coro, were installed between Creole's two 26-in. crude lines without interruption of service.

6. GULF COAST CROSSING . . . River crossings on Cities Service Sour Lake-Rose Bluff crude line were made using electric weld, 5/16-in. wall pipe.

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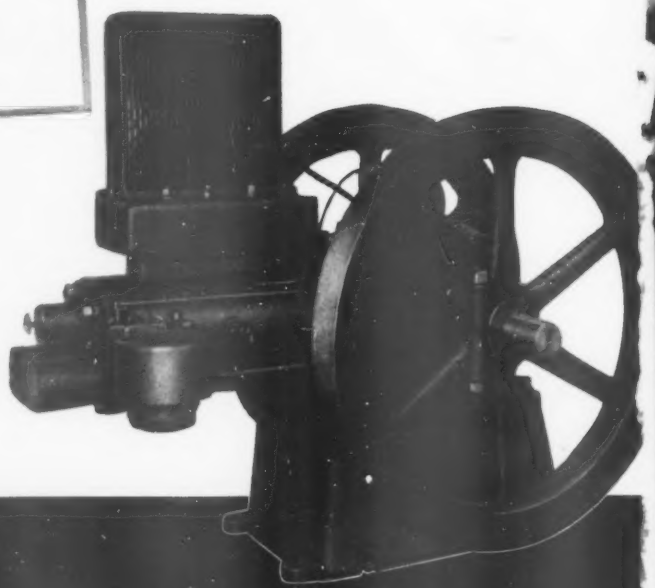
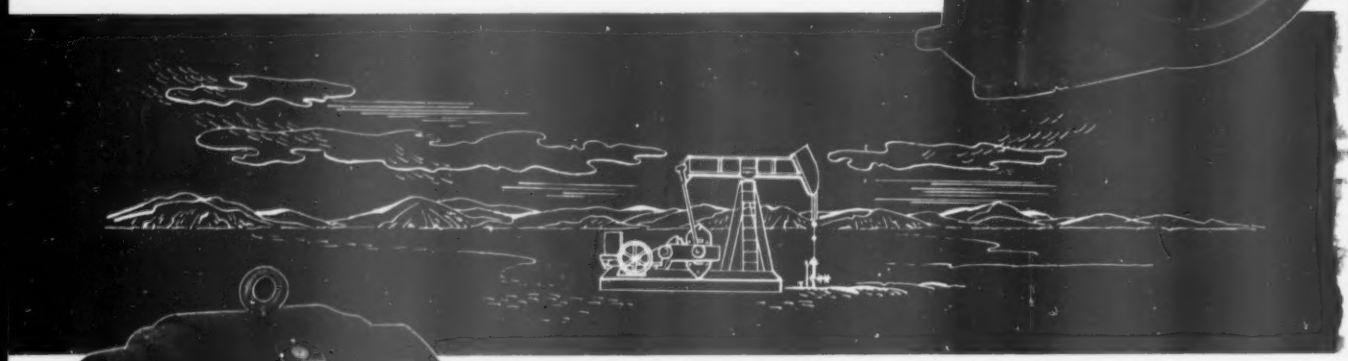
serves you best!



If you choose engines,

the famous Fairbanks-Morse "ZC" is your best choice for economical, efficient service. The big, *extra* heavy flywheels of the "ZC" assure considerable savings in gas or gasoline . . . protect engine and driven equipment against excessive wear. The simple, rugged, single-cylinder "ZC" design means easy maintenance . . . no complicated parts to cause trouble.



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And, remember,

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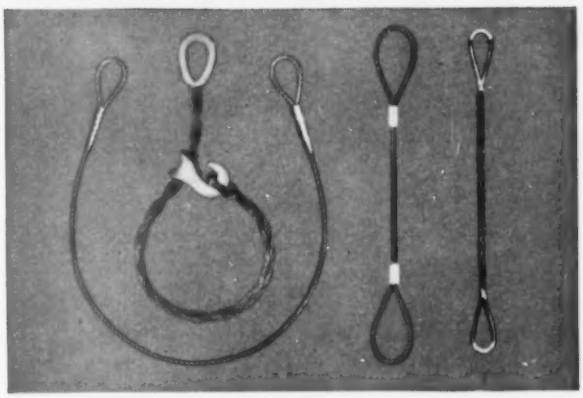

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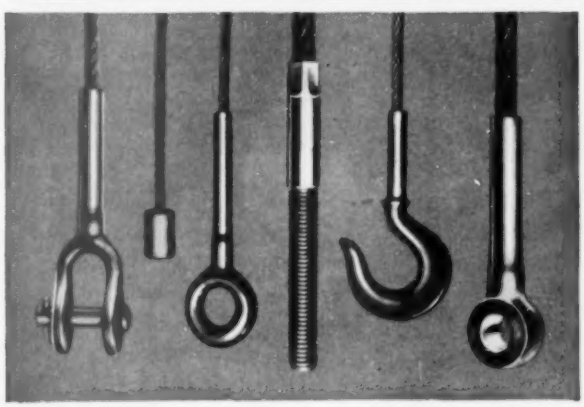
There are hundreds of types and sizes of Macwhyte Round-Braided, Flat-Braided, Single-Part, and Grommet Slings. All are custom made in length, capacity, and flexibility to meet your needs. *Send for Catalog S-8.*



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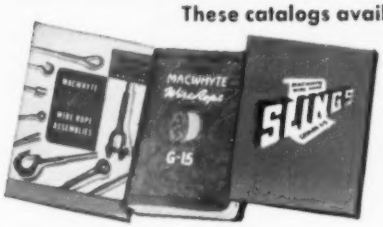

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...at the pressure-capacity range available in the

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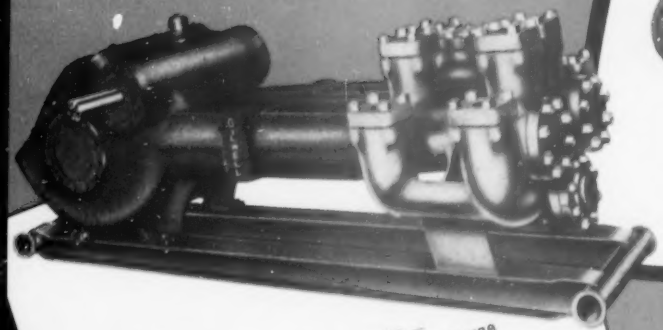
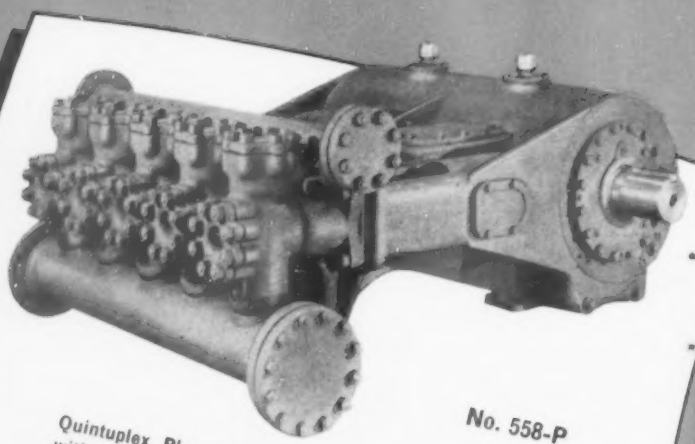
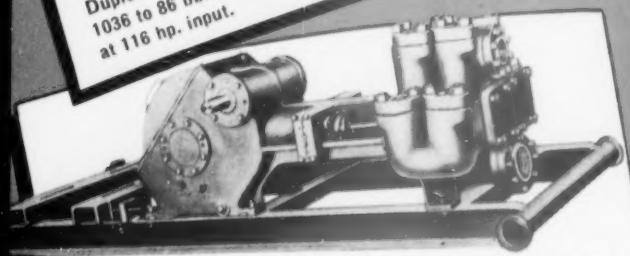


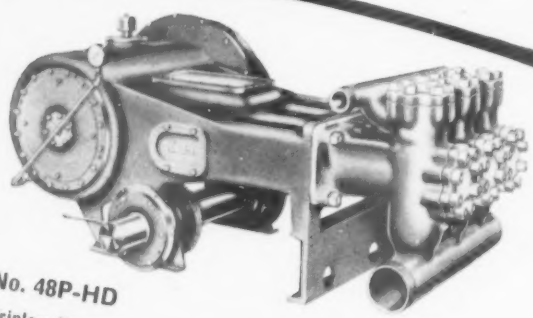
Nos. 810-P, 610-P and 510-P
Duplex Piston Pumps with 10" stroke—1036 to 86 bbls/h with 225 to 1500 p.s.i. discharge at 116 hp. input.



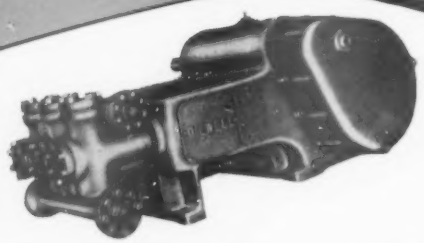
No. 558-P
Quintuplex Plunger Pump with 8" stroke—727 bbls/h with 1270 p.s.i. discharge at 445 hp. input.



Nos. 6P-LD and 6P-HD
Duplex Piston Pumps with 6" stroke—285 to 99 bbls/h with 285 to 830 p.s.i. discharge at 40 hp. input.



No. 48P-HD
Triplex Plunger Pump with 8" stroke—354 bbls/h with 1570 p.s.i. discharge at 280 hp. input.



Nos. 46-P and 36-P
Triplex Plunger Pumps with 6" stroke—249 to 50 bbls/h with 630 to 2800 p.s.i. discharge at 75 hp. input.

***See** . . . your "Oilwell" Representative for complete information on the pumps within the range of your requirements . . . or write for our new Pipe Line Pump Booklet, No. 14-53.*

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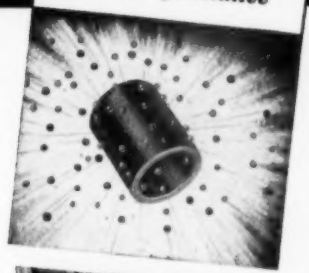
Wraps Up and Delivers 700 H.P.

Shot peened rollers mean extra life, extra performance



In This Brewster Drawworks

DOUBLE, triple and quadruple width Link-Belt Precision Steel Roller Chain in this compound makes three engines drive as one, delivering 700 h.p. for drilling to 10,000 ft. with 4½" pipe. The transmission is equipped with Link-Belt Roller Chain drives and provides four forward and two reverse speeds.

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There is a Link-Belt Precision Steel Roller Chain to fit your need. Call the nearest Link-Belt engineer to give you all the facts.

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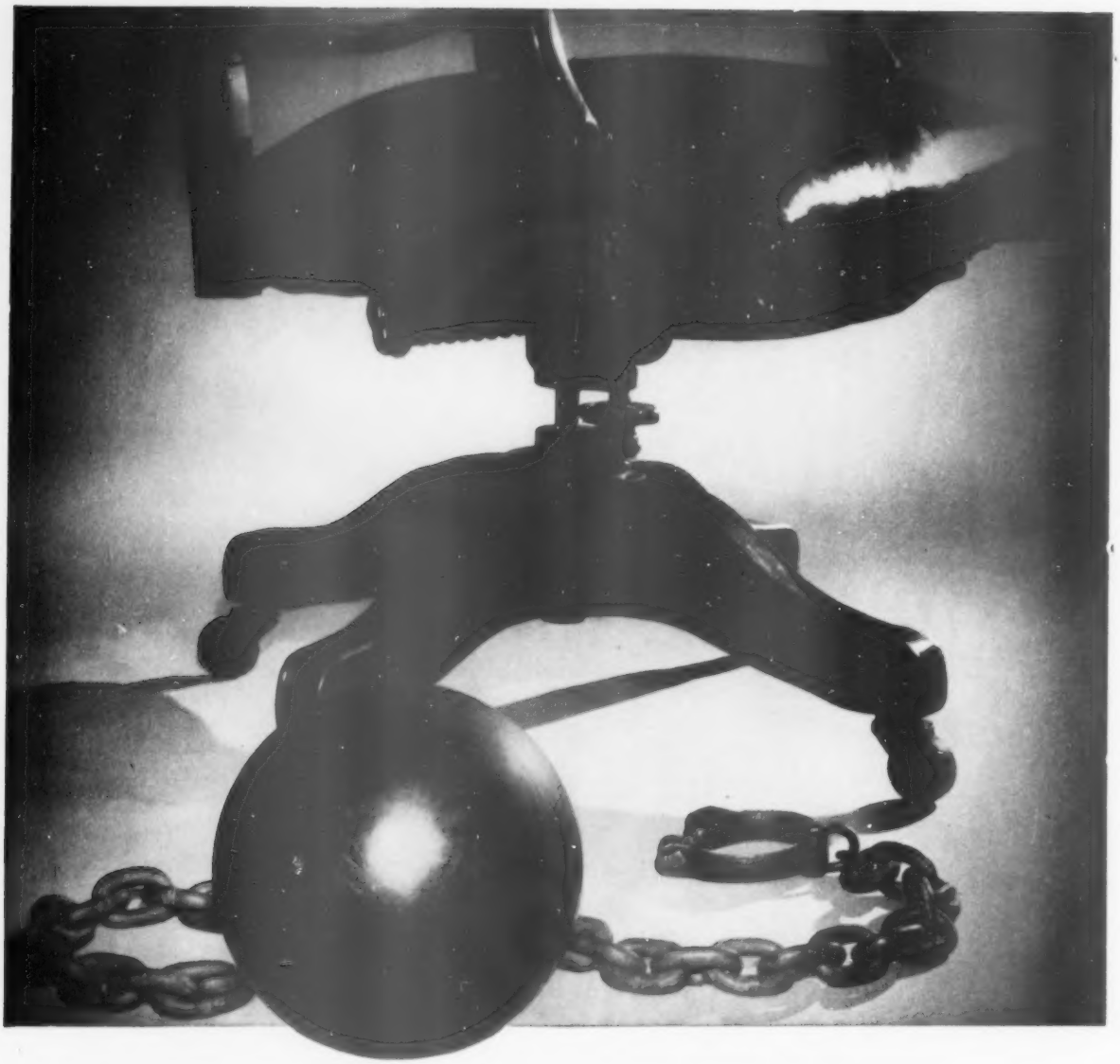

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There's always a field trip you *should* take, some work you *should* do away from the home office.

But ordinary travel methods don't allow you the *time* you need. That kind of ball-and-chain confinement is no longer faced when company-owned Beechcrafts serve you.

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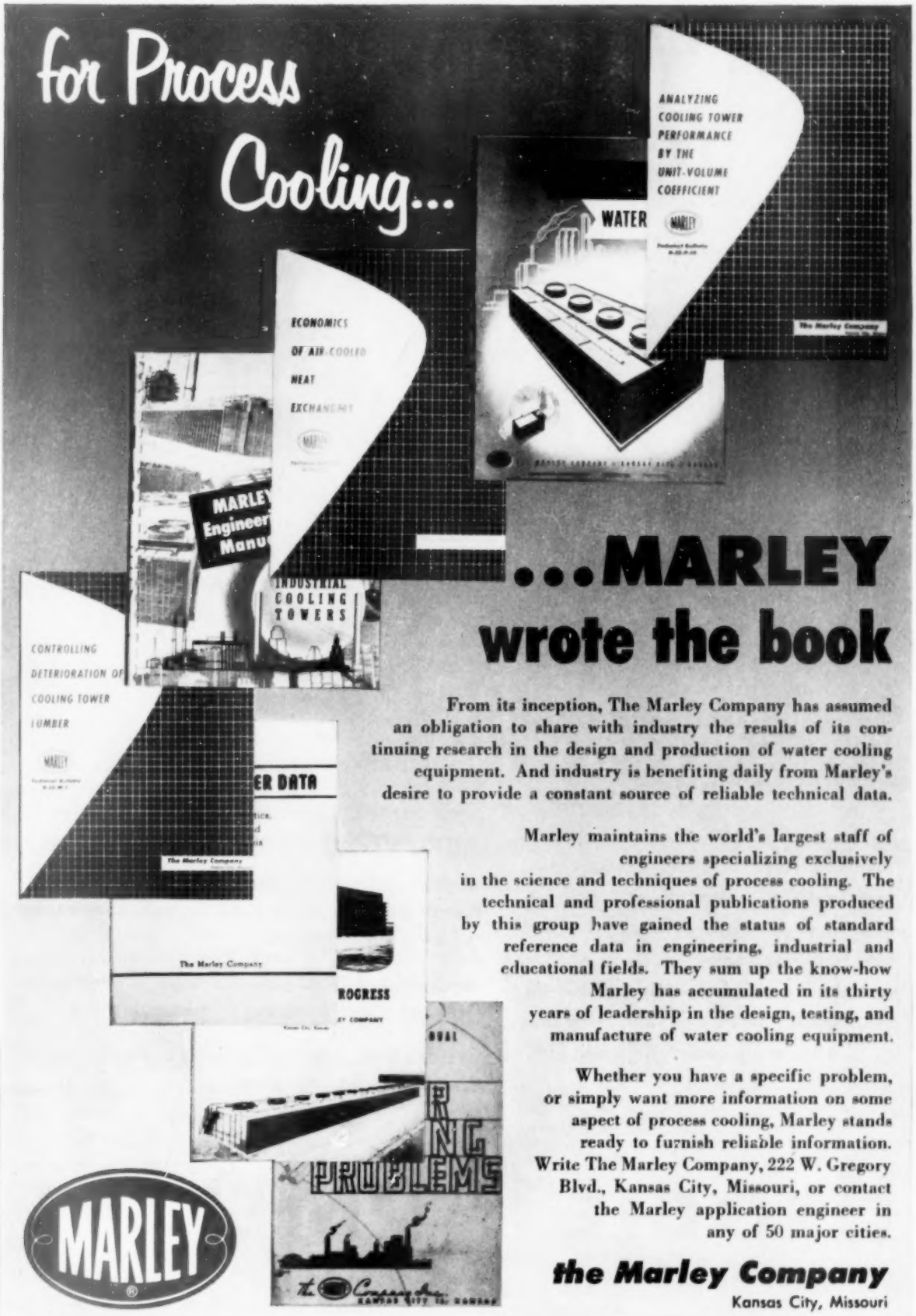

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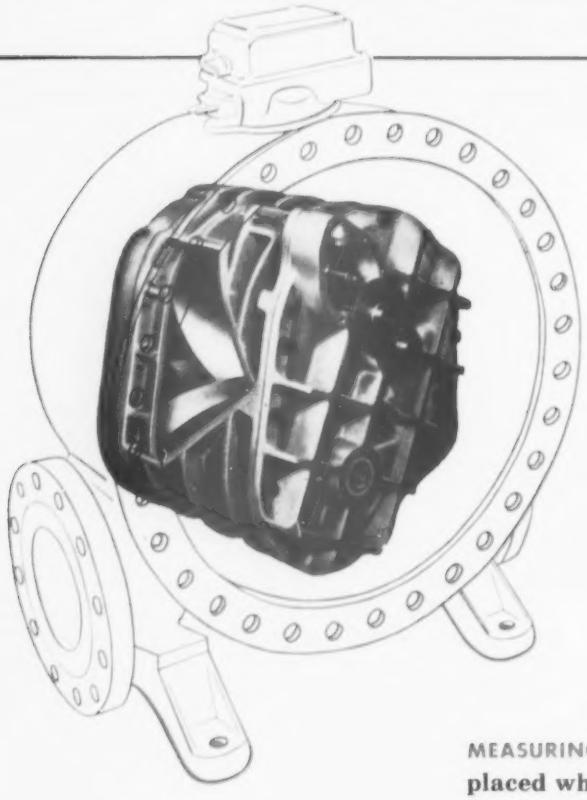

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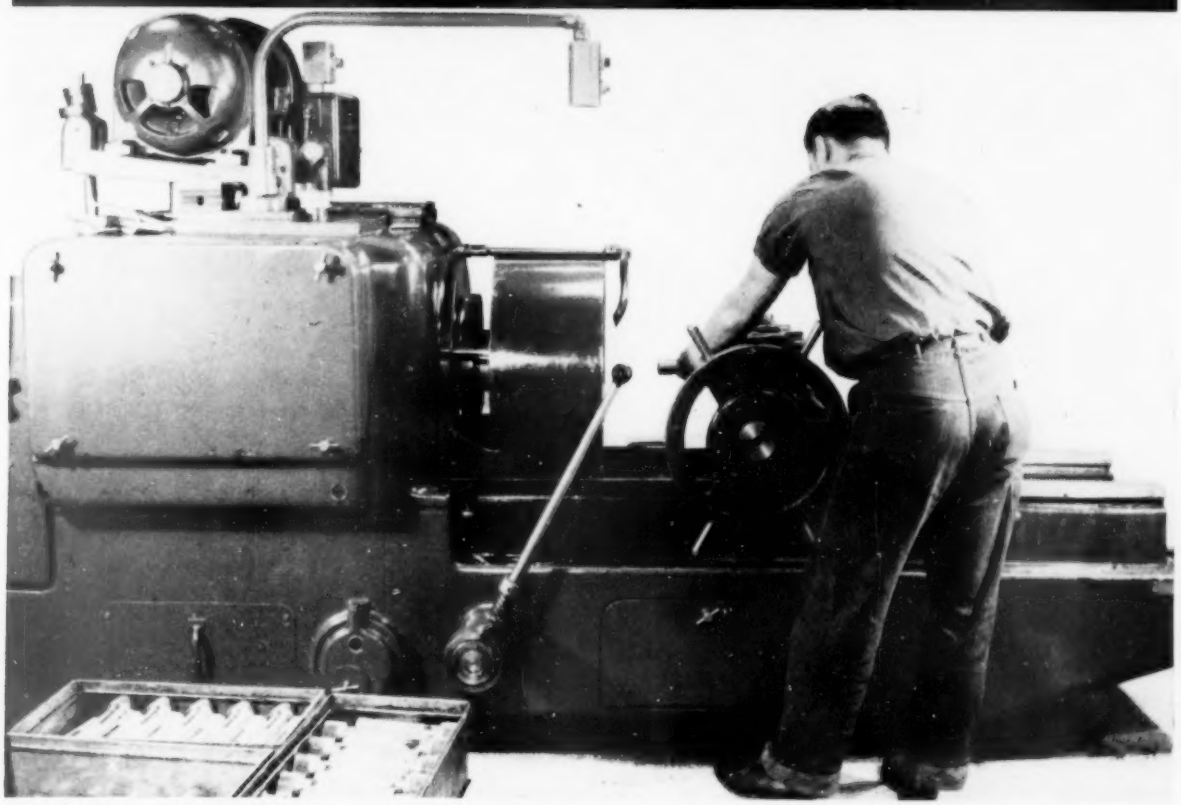
A NEW LANDMACO
for Cutting Large Diameter Threads



HARDENED and GROUND WAYS • WIDE SPEED RANGE • 60% MORE GRIPPING POWER • 6" CAPACITY

A New LANDMACO Threading Machine with many improvements and new design features has been developed for heavy-duty precision threading on large diameter work. The first installation of this new LANDMACO is shown threading "Unbrako" socket head screws of TS4140 steel at the Standard Pressed Steel Company, Jenkintown, Pa. 1½" diameter 12 pitch UN threads are being cut 2 29/32" long to a Class 3 fit.

The carriage front, based on a new principle, assures proper work alignment under gripping pressure and gives 60% more gripping efficiency. Heavy hardened and ground rectangular ways firmly guide and support the carriage.

A single gear shift lever is provided for a rapid speed change of 25% for any given spindle speed as determined by the speed change gears in use. Three pairs of speed change gears provide twelve spindle speeds ranging from 9 to 152 revolutions per minute.

This machine is equipped with either the 4" Standard Rotary Head or the new 6" (6-chaser) Lanco Head. It will cut bolt threads from 1½" to 6⅝" in diameter, and pipe threads from 1" to 6" in diameter. Maximum thread length is 29" with leadscrew and 30" without leadscrew.

For more complete information on this **new** LANDMACO Threading Machine, write for Bulletin #H-45. 381

THE LANDIS *Machine* CO. 50th ANNIVERSARY **WAYNESBORO PENNSYLVANIA**

Represented in the Domestic Oil Fields by: Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; C. J. Harter Machinery, Houston, Texas; Frederic-Baker Co., New Orleans, La.; Moore Machinery Co., Los Angeles and San Francisco, Calif.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.

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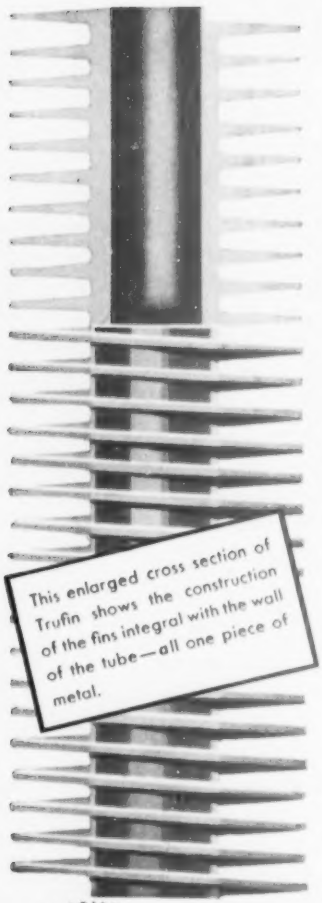
TOMORROW WITH WOLVERINE TRUFIN* YOU CAN REALIZE THE SAME EFFICIENCY IN THIS SMALLER SPACE

This is a graphic picture of what Trufin can do for you. It's worth investigating.



This enlarged cross section of Trufin shows the construction of the fins integral with the wall of the tube—all one piece of metal.

Reduce Size! Reduce Costs!

Because Trufin has an exceptionally wide range of outside-to-inside surface ratio, the opportunity for saving space in heat transfer installation is obvious.

A heat transfer unit or condenser, tubed with Trufin, will occupy a fraction of the space of a unit tubed with plain tube of the same capacity. In this regard you can enjoy one of two advantages: the required capacity in an extremely compact unit or a remarkable increase in capacity in your existing space.

In addition, Trufin, the integral finned tube, has these advantages:

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Trufin is available in a variety of fin spacings, fin heights and alloys, including ferrous or nonferrous metals to meet your specific corrosion requirements.

Let us tell you more about this unusual Trufin. Would you like a data sheet?

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

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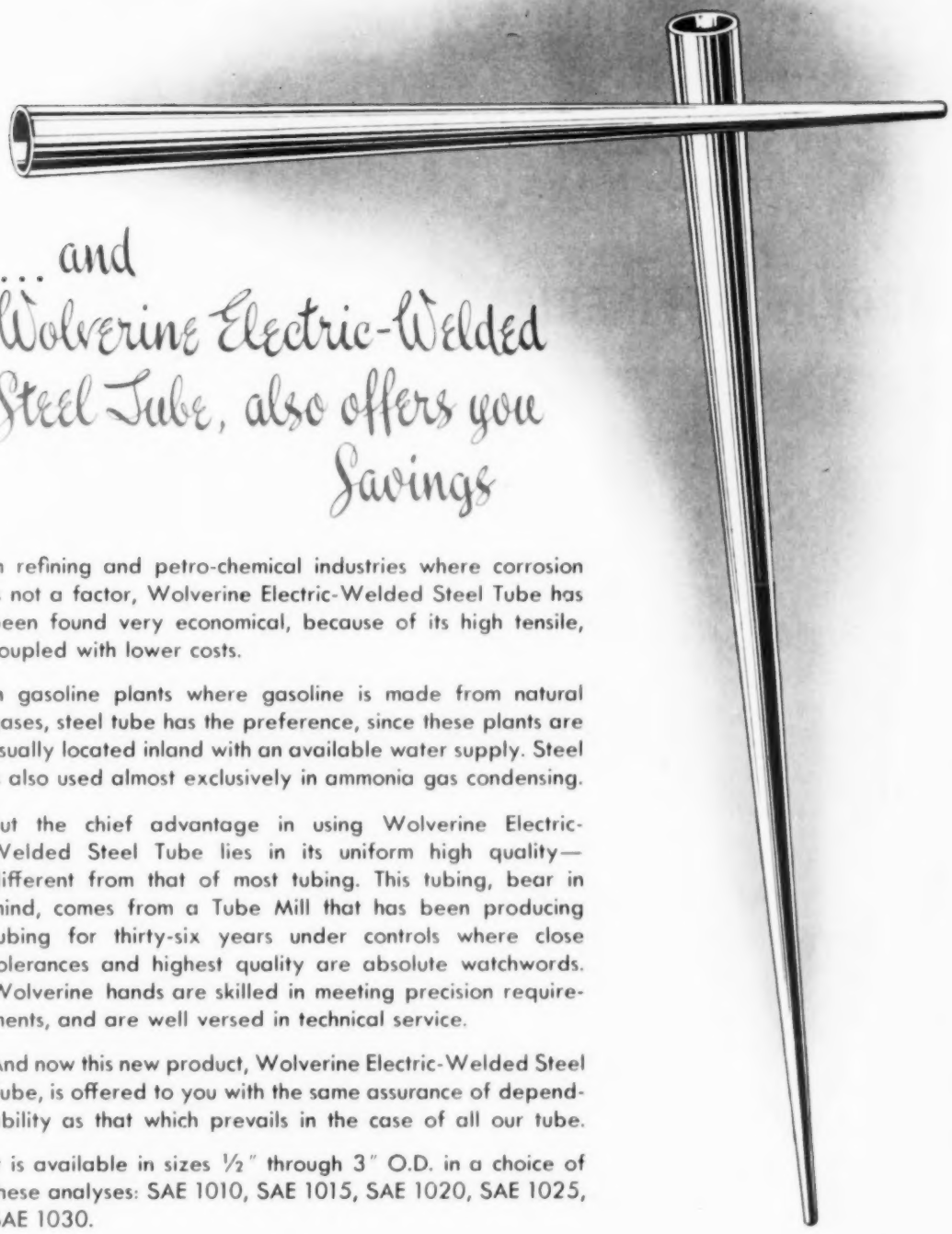


... and Wolverine Electric-Welded Steel Tube, also offers you Savings

In refining and petro-chemical industries where corrosion is not a factor, Wolverine Electric-Welded Steel Tube has been found very economical, because of its high tensile, coupled with lower costs.

In gasoline plants where gasoline is made from natural gases, steel tube has the preference, since these plants are usually located inland with an available water supply. Steel is also used almost exclusively in ammonia gas condensing.

But the chief advantage in using Wolverine Electric-Welded Steel Tube lies in its uniform high quality—different from that of most tubing. This tubing, bear in mind, comes from a Tube Mill that has been producing tubing for thirty-six years under controls where close tolerances and highest quality are absolute watchwords. Wolverine hands are skilled in meeting precision requirements, and are well versed in technical service.

And now this new product, Wolverine Electric-Welded Steel Tube, is offered to you with the same assurance of dependability as that which prevails in the case of all our tube.

It is available in sizes ½" through 3" O.D. in a choice of these analyses: SAE 1010, SAE 1015, SAE 1020, SAE 1025, SAE 1030.

WOLVERINE TUBE DIVISION
of CALUMET & HECLA, INC.

ESTABLISHED 1916

Manufacturers of Quality-Controlled Tubing
1459 CENTRAL AVENUE • DETROIT 9, MICHIGAN

Plants in Detroit, Mich. & Decatur, Ala. *Sales offices in Principal Cities*

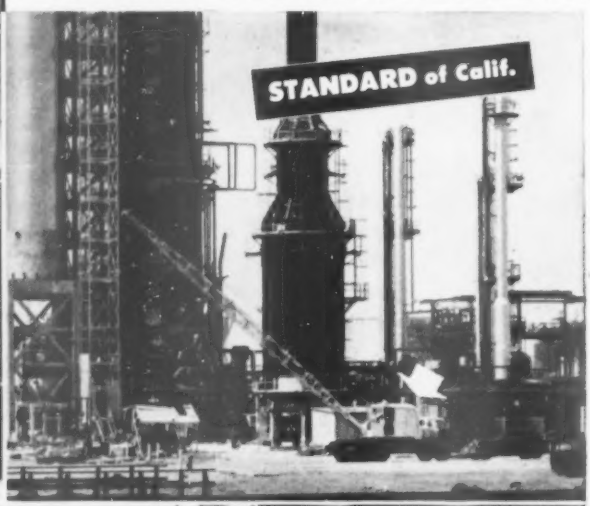
EXPORT DEPT., 13 E. 40th ST., NEW YORK 16, N. Y.

LORAINS on rubber...

GO PLACES—
GET THINGS DONE—
FAST—
AROUND REFINERIES!

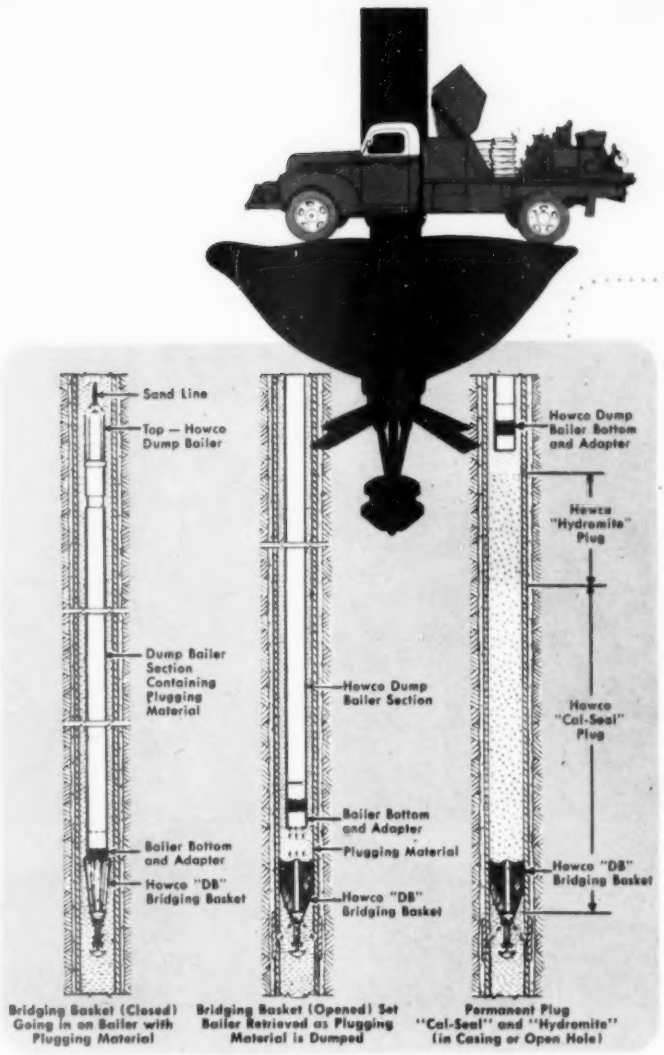
To get around quickly — to get jobs done in a hurry, why not apply the modern Lorain rubber-tire crane method to *your* refinery operations? Here are 4 big-name oil companies that find important savings and economies — with Lorain rubber-tire Cranes. These versatile Lorains lift and load material and equipment of all kinds — can excavate and erect — handle still and condenser maintenance . . . and roll quickly on rubber to wherever the job is. They are available in capacities of from 6 to 45 tons, can handle a wide variety of materials — from sand to steel. 4 or 6 wheel drive arrangements on Self-Propelled or Moto-Crane types can be fitted to travel conditions. When you are ready "to go places", ask your Thew-Lorain Distributor to show you the way with a Lorain on rubber tires!

THE THEW SHOVEL CO., LORAIN, OHIO



OIL MEN PREFER THE NAME THEW LORAIN

SHOVELS • CRANES • DRAGLINES
CLAMSHELLS • HOES


Sand Line
Top — Howco Dump Bailer
Dump Bailer Section Containing Plugging Material
Bailer Bottom and Adapter
Howco "DB" Bridging Basket
Howco Dump Bailer Section
Bailer Bottom and Adapter
Plugging Material
Howco "DB" Bridging Basket
Howco Dump Bailer Bottom and Adapter
Howco "Hydromite" Plug
Howco "Cal-Seal" Plug
Howco "DB" Bridging Basket
Bridging Basket (Closed) Going in on Bailer with Plugging Material
Bridging Basket (Opened) Set Bailer Retrieved as Plugging Material is Dumped
Permanent Plug "Cal-Seal" and "Hydromite" (in Casing or Open Hole)

OPERATING DIAGRAM FOR "DB" BRIDGING BASKET

PLUGS DEEP IN 1 TRIP!

HALLIBURTON'S DUMP BAILER and BRIDGING BASKET

Deep well remedial problems are being solved swiftly in just *one trip* by a new plug-building combination: Halliburton's DB Bridging Basket and Dump Bailer Bottom. The result is well-down-time saved.

Adapting the umbrella-type DB Bridging Basket and running it on a Halliburton Dump Bailer Bottom eliminates one round trip – and makes permanent or temporary plug-building a smooth, simultaneous operation in open hole or casing.

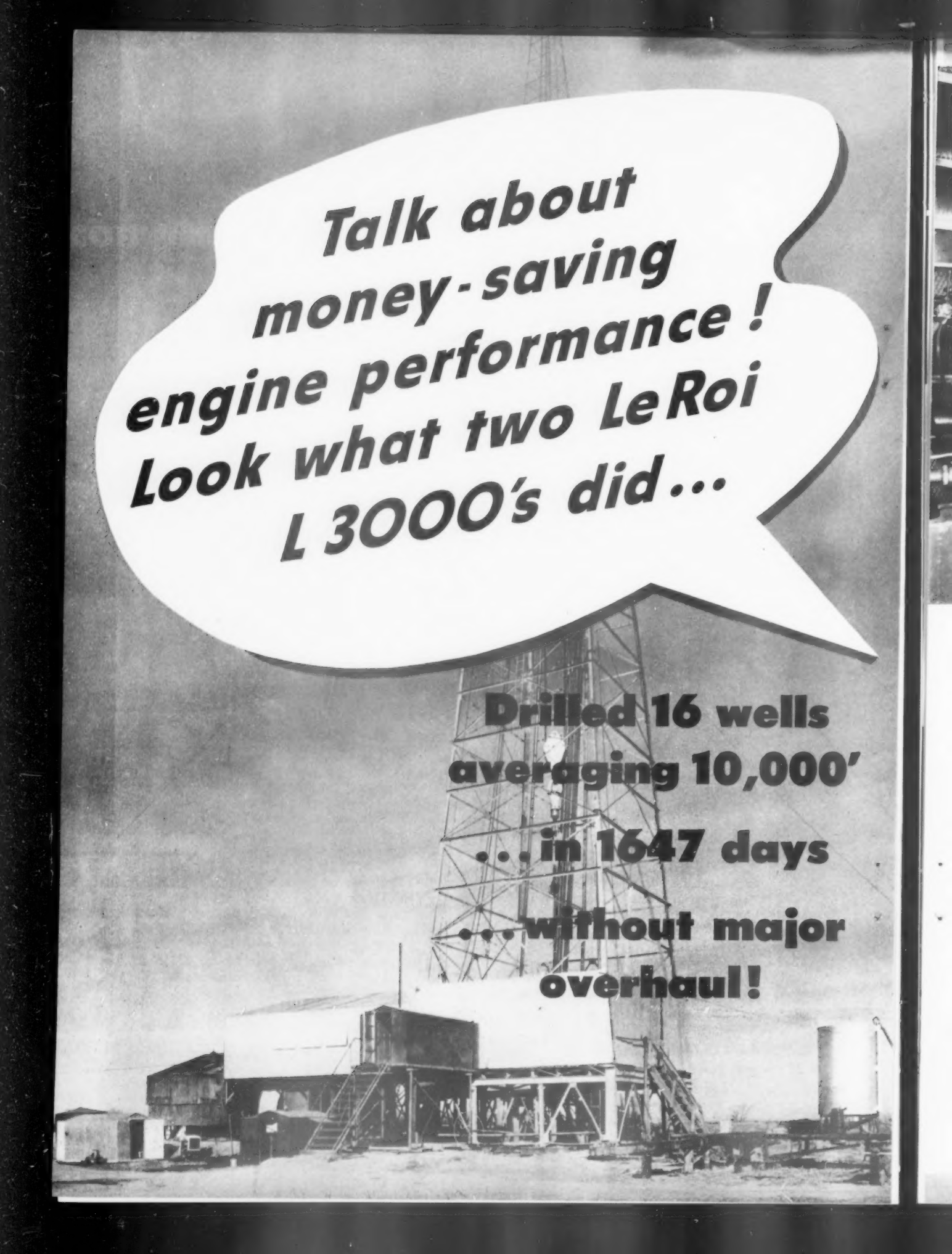
Operation is extremely simple. A very slight pickup on the string of bailers not only sets and opens the umbrella bridging basket, but dumps the plugging material into the open umbrella at the same time.

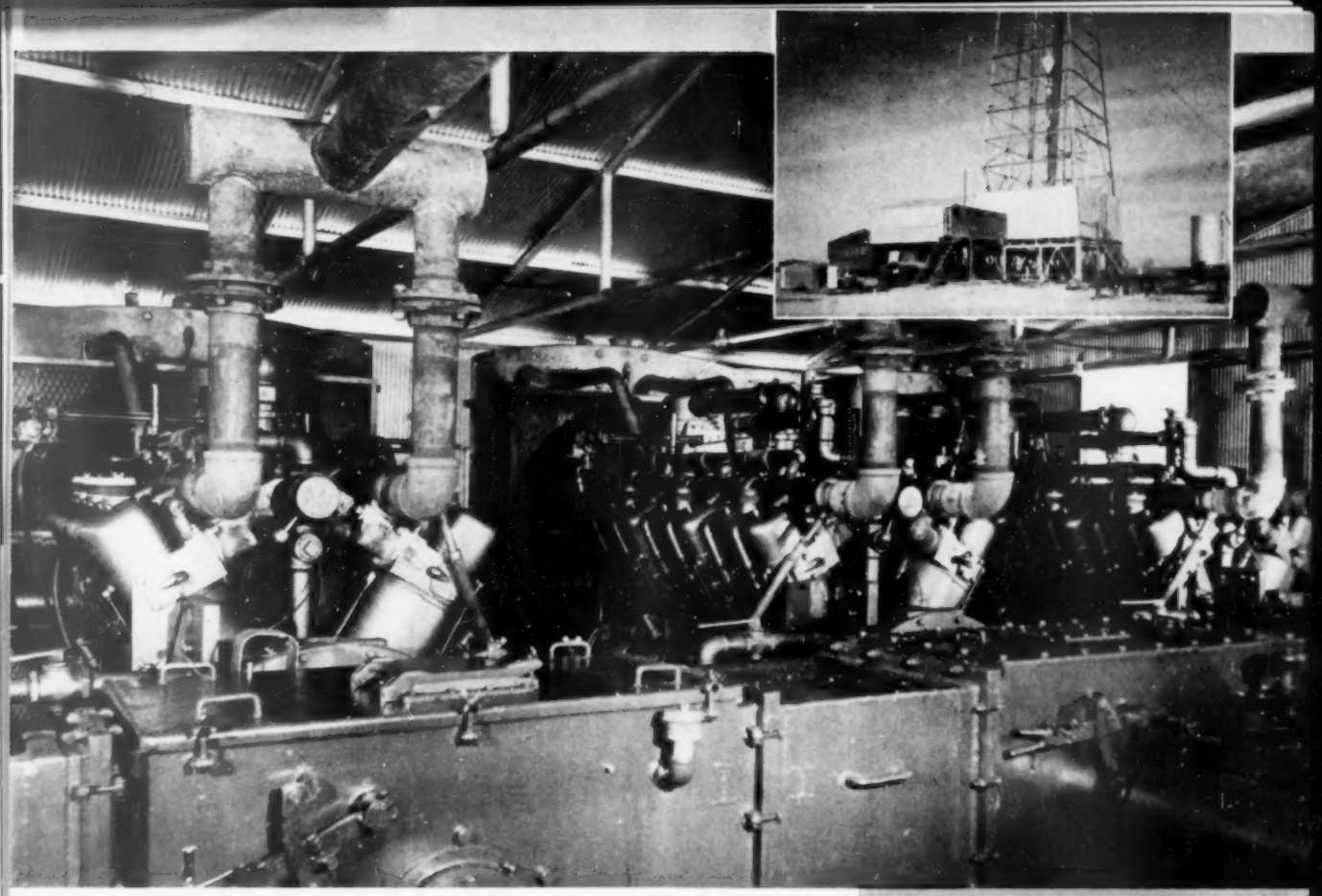
Halliburton's effective Dump Bailing Service combination has proved its versatility by building plugs with Cal-Seal, Hydromite, and other plugging materials to solve a variety of remedial jobs: isolating formations; locating and repairing casing leaks; perforating casing; acidizing in suitable formations; plugging back before cementing liner; shooting formation below; plugging back to abandon well, and minimizing caving in a cable tool hole.

For your next remedial job, specify this valuable Dump Bailer Service to get a better plugging job in just one trip. Use the combination that has proved its effectiveness in hundreds of wells, including several more than 13,000 feet deep. Simply phone your nearby Halliburton representative. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

YEARS AHEAD IN REMEDIAL SERVICING!

HALLIBURTON


Talk about money-saving engine performance! Look what two LeRoi L 3000's did...
Drilled 16 wells averaging 10,000'
...in 1647 days
...without major overhaul!



ALMOST 5 years of drilling service — with but very little repair work and only an occasional top overhaul! That's real performance — the kind of performance two Le Roi L3000's gave Trigg Drilling Company of Oklahoma City.

And — they delivered the power, the fast acceleration, the vibration-free operation Le Roi engines have long been famous for. Thanks to this exceptional power and smoothness, they handled 15,000 feet of 4½" drill pipe easily, according to Mr. Clay Trigg.

It's no wonder Trigg Drilling Company selected Le Roi to power the three-engine rig shown above. It's no wonder they now have a total of seven L3000's on their three rigs and an additional two Le Roi H2000's.

Reports from all fields show that you can count on Le Roi for dependability and economy under continuous loads. You can count on Le Roi for lugging power at slow speeds. You can count on Le Roi for plenty of reserve power to help your crew out of the tight spots.

Enjoy these advantages — insist on Le Roi power on original equipment and as replacement engines. Ask your rig manufacturer, supply house, or Le Roi distributor to show you Le Roi engines at work.

LE ROI

LE ROI COMPANY

A Subsidiary of Westinghouse Air Brake Co.

MILWAUKEE 14, WISCONSIN

Plants: Milwaukee • Cleveland • Greenwich, Ohio

Oil Field Headquarters: Tulsa, Oklahoma

P-119

Service as Near as Your Telephone

Complete parts stocks . . . Skilled mechanics on 24-hour call . . . Unexcelled overhaul facilities

Oilfield Sales-Service Network

Oklahoma
Le Roi Company Branch — Tulsa
Carson Machine & Supply Co. — Oklahoma City.

East & South Texas, Gulf Coast
Southern Engine and Pump Company — Houston, Kilgore, Edinburg, Dallas, San Antonio, Corpus Christi, Texas, and Lafayette, Houma, Louisiana.

North & West Texas, New Mexico
General Machine & Supply Co. — Odessa, Snyder, Texas.
Norton Engine & Equipment Co. — Wichita Falls, Texas.

Kansas
Carson Machine and Supply Co.—Great Bend.

Illinois — Western Kentucky
Western Machinery & Engine Company — Centralia, Illinois and St. Louis, Missouri.

Michigan
Hofer Engine Service — Reed City

Rocky Mountain Area
Gehring Equipment Co. — Casper, Wyoming, Raegely, Col.

Mississippi, Arkansas and Northern Louisiana
Ingersoll Corporation — Shreveport, Louisiana, Jackson, Mississippi, El Dorado, Arkansas.

West Coast
Le Roi Engine Sales Co.
Long Beach, California

Appalachian Area
P. C. McKenzie Co., Pittsburgh, Bradford.

Canada
Lucey Export Ltd. — Calgary, Edmonton, Alberta.

ROCKWELL Type PLX
FOR PRODUCT PIPE LINES

Measure Better— Profit More!

At the *business end* of any pipe line it will pay you *more* to measure with Rockwell Rotocycle meters. Consider these money saving, money earning facts. The exclusive Rotocycle design has a measuring chamber in which all parts freely revolve on anti-friction bearings. There is no metal-to-metal contact to cause wear. The motion is always in the direction of the fluid flow. It is identical to that of an electric motor.

This smooth, friction-free "Flo-ward" operation offers the least resistance to line flow. Thus with Rockwell Rotocycle meters you can save by using smaller propulsion units on your pumps and pay smaller bills for electric power.

There are now five sizes of these better meters available for either high or low pressure service. Temperature compensators, straight reading or printing registers are optional. Write for bulletins.

ROCKWELL MANUFACTURING COMPANY
PITTSBURGH 8, PA.

Atlanta Boston Chicago Houston Kansas City Los Angeles New York Pittsburgh San Francisco Seattle Tulsa

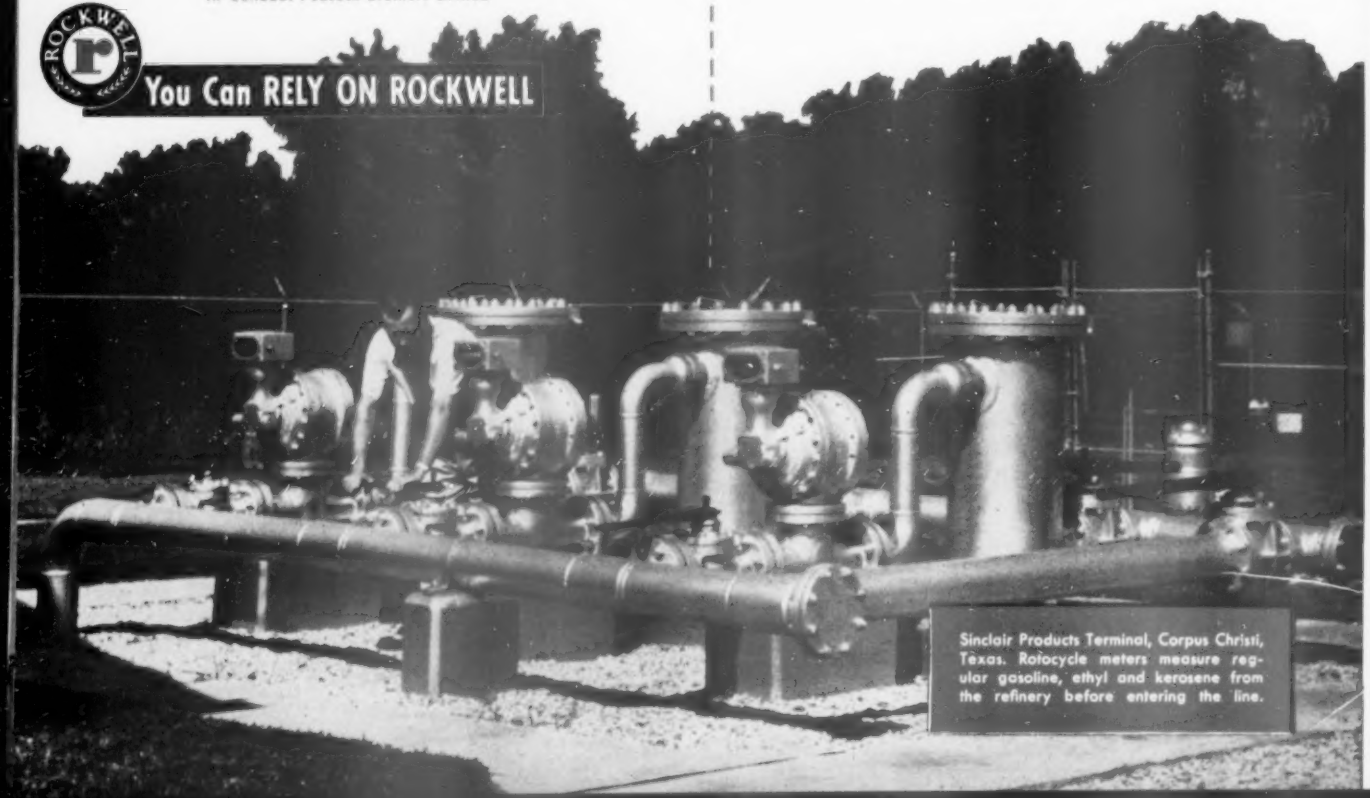
In Canada: Peacock Brothers Limited

ROTOCYCLE METERS

Type 6-PLX Pipe Line Meter with printing register.

Always the most positive of all rotary type meters, the Rotocycle meter design has been improved and refined to give even longer life, greater sustained accuracy. What's more, these improvements have been engineered so that the new rotor construction is interchangeable with the old—making conversion easy—in the field, if desired.

You Can RELY ON ROCKWELL



Sinclair Products Terminal, Corpus Christi, Texas. Rotocycle meters measure regular gasoline, ethyl and kerosene from the refinery before entering the line.

Get More Pipe Line Oil

with BREAXIT
REGISTERED U. S. PAT. OFF.

Emulsion Breaking Compounds

ADAPTED TO EACH JOB

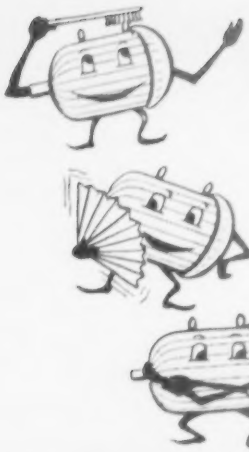
Emulsion-breaking Breaxit compounds are specially formulated for each job. An experienced Breaxit engineer makes an on-the-spot test of the live oil your well produces. After careful study he determines the type and amount of Breaxit compound needed to give you pipe line oil. Then the nearest Breaxit distributor makes delivery of the required Breaxit compound to your lease.

BREAXIT IS SOLD BY

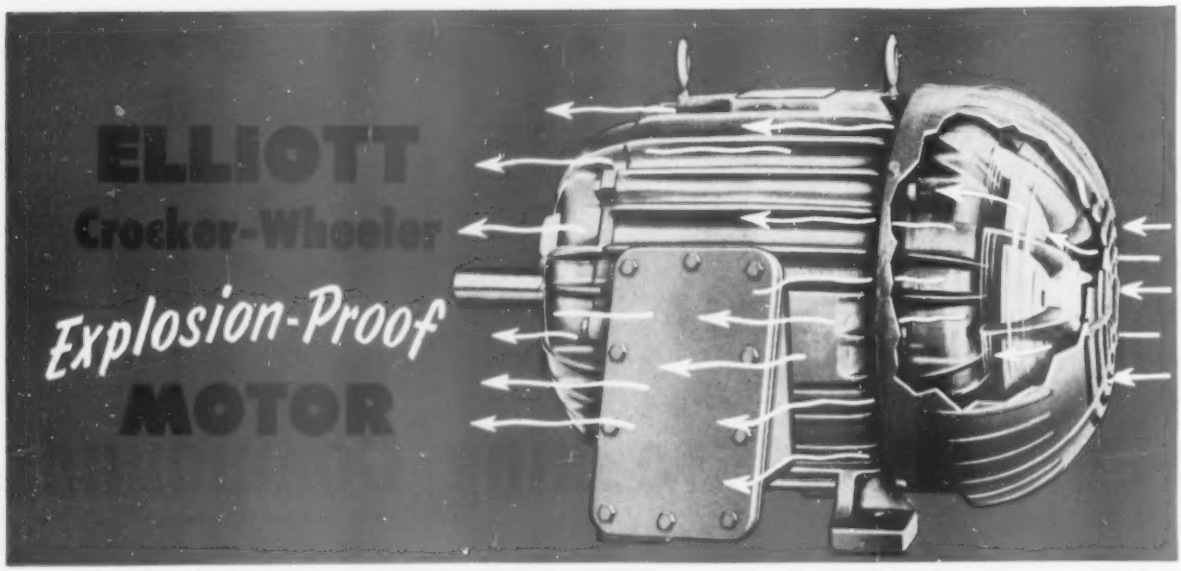
HUMBLE

HUMBLE OIL & REFINING COMPANY
HOUSTON, TEXAS

On-the-lease testing and prompt to-the-lease delivery.

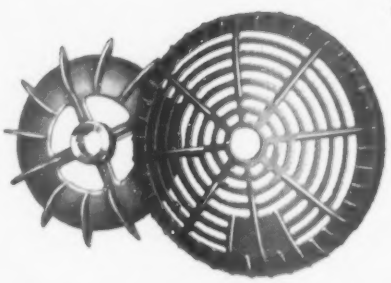


It's self-cleaning!
It's self-cooling!
It's explosion-proof!



Here's a totally-enclosed motor that acts as its own heat exchanger, driving a directed blast of air around the *outside* of the motor along the full length of the heat-radiating fins. This air blast not only sweeps off heat as fast as it is developed, but also prevents the settling of dust or other material on the motor, building up an additional barrier to the release of heat.

Now available with explosion-proof enclosure, underwriters approved, the Elliott Crocker-Wheeler Sealedpower is an ideal motor for hazardous locations, indoors or out. Refineries, natural gasoline plants, pipe lines, chemical plants, flour mills — everywhere in fact where totally-enclosed motors with explosion-proof qualities are a must — are using rugged Elliott C-W Sealedpower motors with full satisfaction. In NEMA frames, ratings to 100 hp. For full data, contact your nearest Elliott district office or write Elliott Company, Jeannette, Pa.

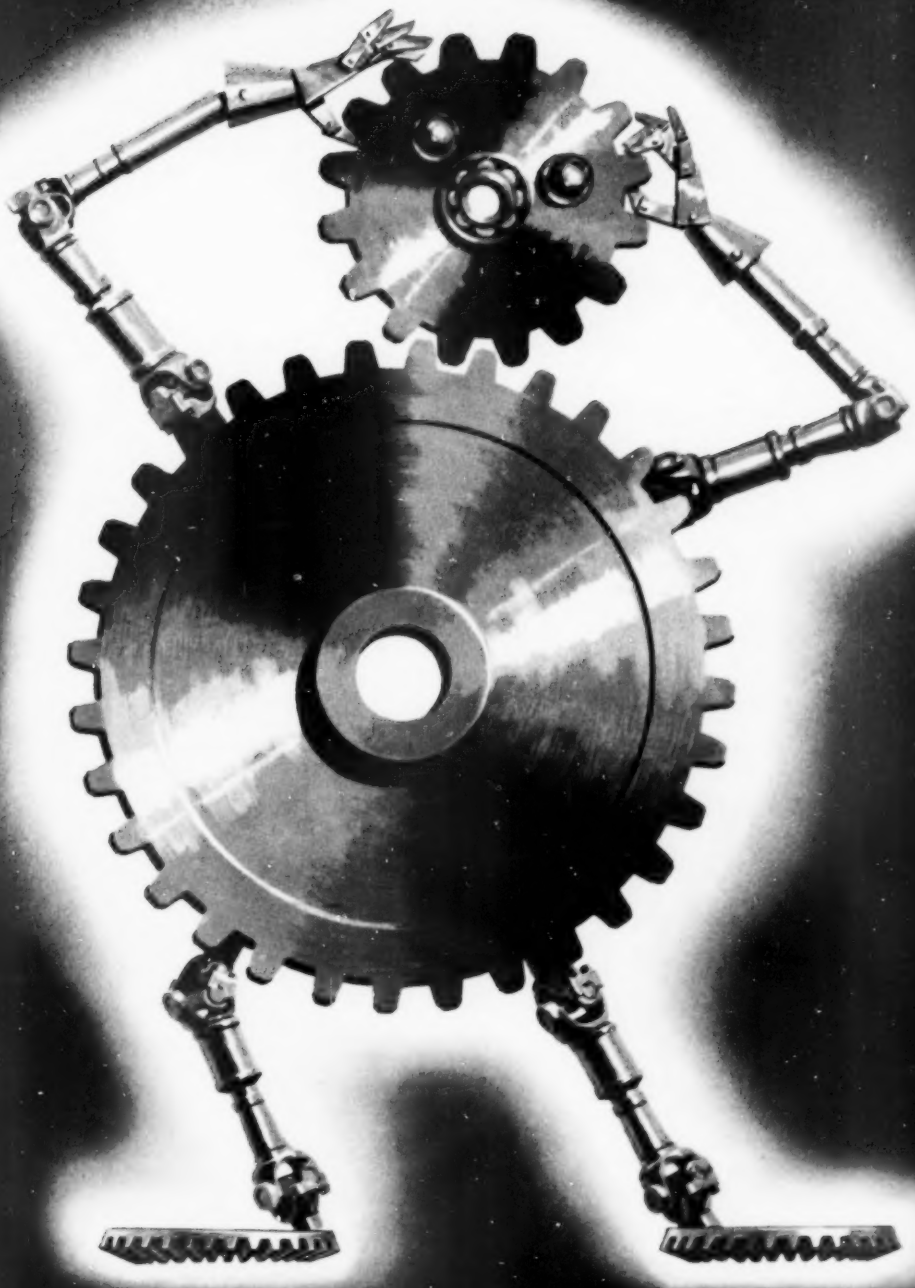


THE FAN AND COWL. *Fan is one-piece, non-sparking bronze. The cowl is of gray cast iron, so designed as to direct the flow of cooling air along the outside surface of the frame.*

ELLIOTT Company

CROCKER-WHEELER DIVISION

W3-9



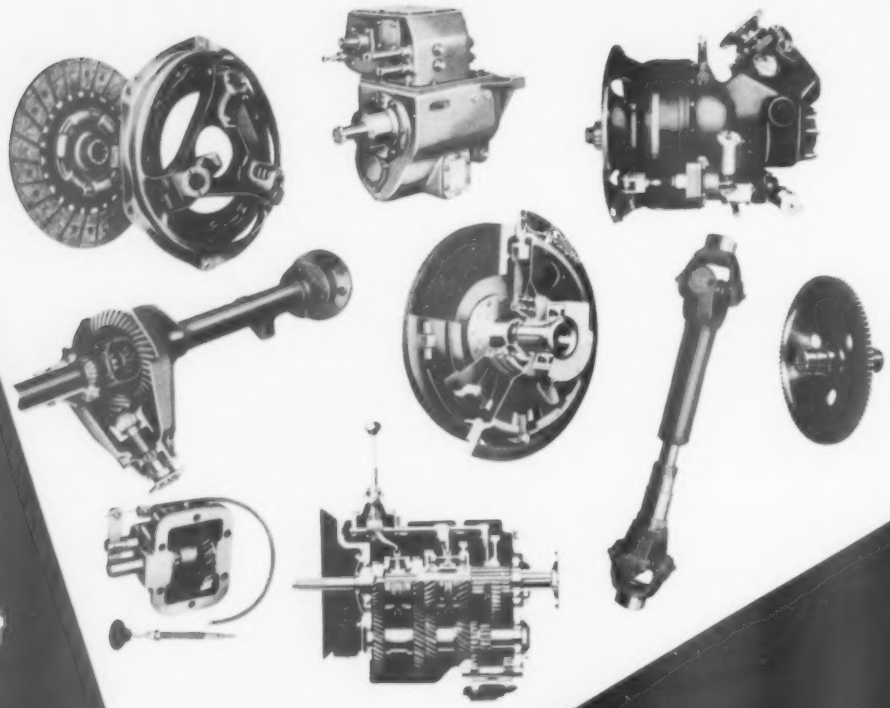
We specialize in making things come out right

Spicer has developed a fine balance between mechanical excellence and human efficiency during the past 50 years. This combination makes things come out right . . . in the plant . . . in the field. It is one of the big reasons why Spicer power transmission units have become the

Standard of the Industry

Designing, Developing, Engineering, Manufacturing and Service

Spicer



CORRECT
in the plant

With 10 modern plants doing much of their processing from raw material to finished product . . . with engineering genius and manufacturing skill of the highest order . . . Spicer controls and maintains quality standards acclaimed in the industry.

CORRECT
on the road

Millions and millions of automotive vehicles of every type have proved the correctness of Spicer equipment with billions of service miles throughout the world. Spicer "follow-through" in the plant pays big dividends to the automotive manufacturer and his buyers . . . in performance and prestige.

SPICER MANUFACTURING DIVISION
of Dana Corporation · Toledo 1, Ohio

49 YEARS OF
Spicer
SERVICE

ENGINEERING
DANA
MANUFACTURING

TRANSMISSIONS • UNIVERSAL JOINTS • PROPELLER SHAFTS • BROWN-LIPE AND AUBURN CLUTCHES • FORGINGS • AXLES • STAMPINGS • SPICER "BROWN-LIPE" GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES • WELDED TUBING

Dependable.. under all Service or Climatic Conditions

LIMITORQUE®
VALVE CONTROLS

The experience of many of the world's major pipe and refineries lines prove the reliable performance of LimiTorque Controls. For years, many thousands of these operators have been opening and closing all types of valves, in all kinds of weather. This surety of performance is vital where the valves are located in remote spots and operated from conveniently placed push-button and indicator-light panels. The LimiTorque mechanism provides unfailing protection from damage to valve operating parts during the closing cycle.

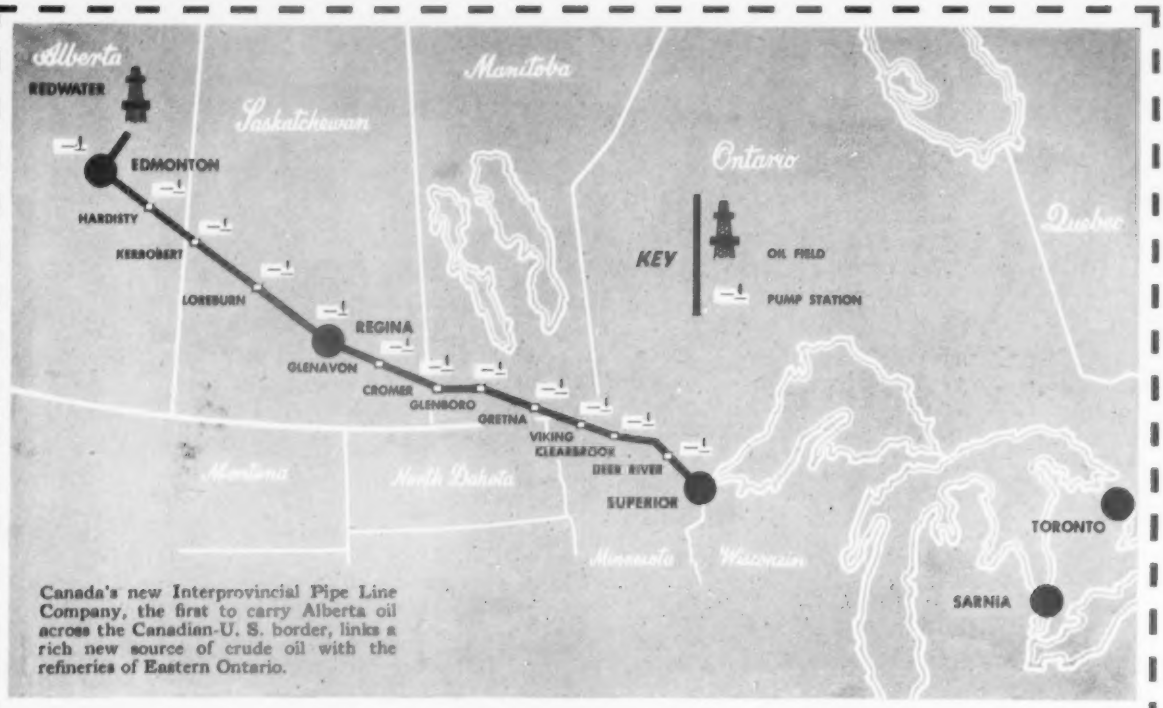
It's no wonder there are more LimiTorque Controls in service than all other makes. ***Write us for literature.***

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls



Canada's new Interprovincial Pipe Line Company, the first to carry Alberta oil across the Canadian-U. S. border, links a rich new source of crude oil with the refineries of Eastern Ontario.

Alco Diesel Engines Pump Alberta Oil 1137 miles to U.S. Port on Great Lakes

Canada's new 1137-mile Interprovincial Pipe Line and its American Subsidiary, Lakehead Pipe Line Company, Inc., offer an outstanding example of international teamwork—and open a new era in the history of Canadian petroleum.

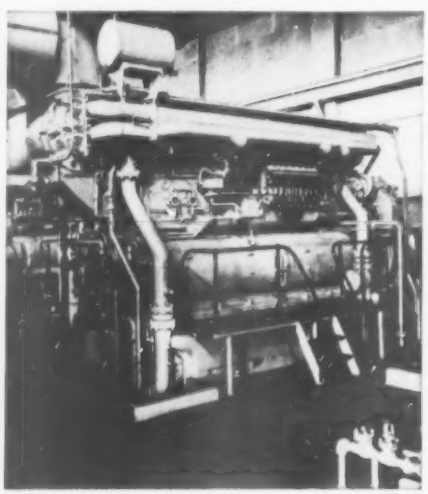
Served by Alco Diesel Engines, this first major Canadian pipeline (approximate annual capacity: 58.5 million barrels out of Edmonton) carries crude oil from the rich fields of central Alberta to the strategically located Great Lakes port of Superior, Wisconsin, from where it is transported to the refineries of Eastern Ontario.

Nine of the line's twelve pumping stations are located in Canada, three in the U. S. (see map). Each is powered by either two, three or four Alco Diesel Engines. Units for the Canadian stations were built under Alco license by the Dominion Engineering Works of Montreal; U. S. units were built in Alco's diesel plant at Auburn, N. Y.

Some of these 12½ in. x 13 in. engines have six cylinders and others, eight. Some are straight diesel and others are dual fuel. All of the engines are suitable for burning available crude oil.

The new Interprovincial Pipe Line is just one more major installation where the compactness, efficiency and flexibility of Alco Diesel Engines are helping to meet the free world's growing demand for petroleum products.

Your nearest Alco sales representative will be happy to give you detailed information on Alco Diesel Engines. Contact him at New York, Beaumont, Chicago, Cleveland, Houston, Kansas City, San Francisco, Schenectady or St. Louis.

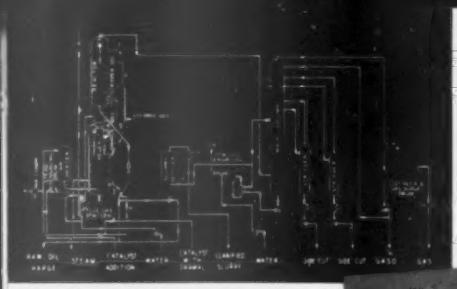


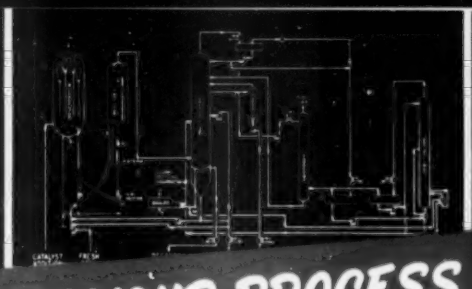
Eight cylinder, 12½ in. x 13 in. Alco dual-fuel Diesel Engine, manufactured in Canada by Dominion Engineering Works, Montreal, shown in engine room of the Interprovincial's Edmonton, Alberta, pumping station.

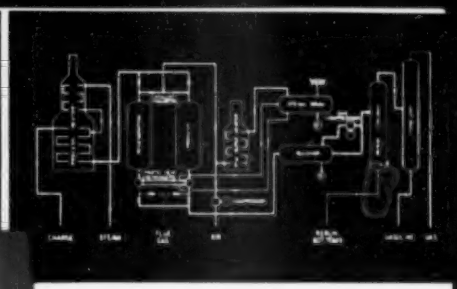
ALCO DIESELS

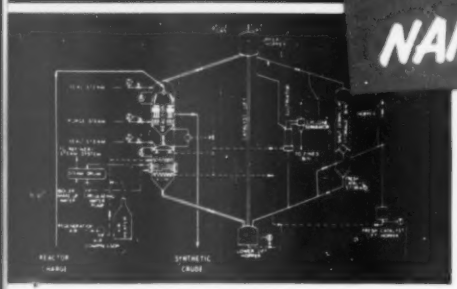
AMERICAN LOCOMOTIVE COMPANY
SCHENECTADY, N. Y.

The mark of modern engineering









NAME YOUR PROCESS

National Tube can supply the right pipe and tubes

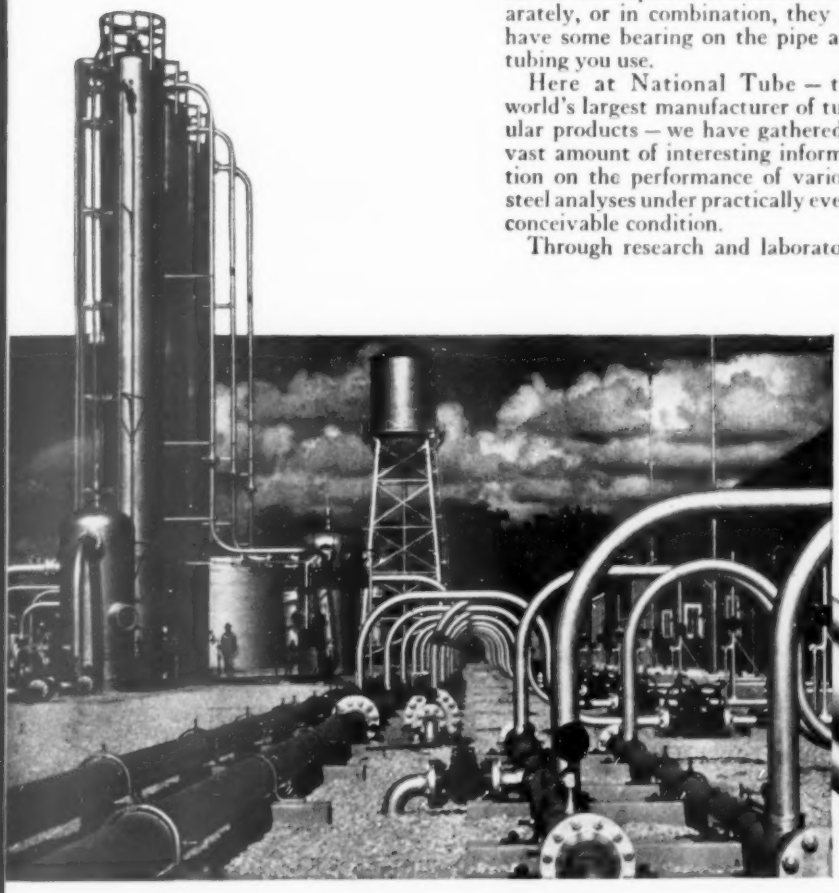
IN THE NUMEROUS TECHNIQUES employed in modern refining processes, pipe and tubing plays an essential and often widely diversified role. That is why the 24 *different* analyses which we can offer in National Seamless Pipe and Tubes are so important.

MANY considerations enter into the selection of refinery pipe and tubes. Different processes. Different production techniques. Temperatures. Pressures. Corrosives. Acids. Atmospheric conditions. Separately, or in combination, they all have some bearing on the pipe and tubing you use.

Here at National Tube — the world's largest manufacturer of tubular products — we have gathered a vast amount of interesting information on the performance of various steel analyses under practically every conceivable condition.

Through research and laboratory experiments; through on-the-scene observations; and by studying actual installations with the men in charge, we have developed 24 different analyses of Still Tubes, Condenser and Heat Exchanger Tubes, and Refinery Piping.

That's why we say: *bring your problems to National Tube.* If conditions at your plant are new to our engineers, you can be sure that we will not make a recommendation without first satisfying ourselves that we have come up with the right analyses for your particular requirements. An inquiry entails no obligation on your part.



NATIONAL TUBE offers you Seamless Steel Still Tubes . . . Condenser Tubes . . . Heat Exchanger Tubes . . . Refinery Piping . . . in 24 DIFFERENT ANALYSES

Carbon	2 Cr, ½ Mo	5 Cr, ½ Mo
Carbon, ½ Mo	2¼ Cr, 1 Mo	5 Cr, ½ Mo, 1½ Si
½ Cr, ½ Mo	2½ Cr, ½ Mo, ¼ Si	5 Cr, ½ Mo, Ti
1 Cr, ½ Mo	3 Cr, 1 Mo	7 Cr, ½ Mo
1¼ Cr, ½ Mo		8 Cr, ½ Mo
		8 Cr, 1 Mo
		9 Cr, 1 Mo
		12 Cr, Al
		17 Cr
		27 Cr
		18-8
		18-8 Ti
		18-8 Cb
		18-8 Mo
		25-20

All National Seamless Tubes are pierced from a solid billet of high-quality steel. This is the one method that removes all doubt concerning uniform wall strength.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.

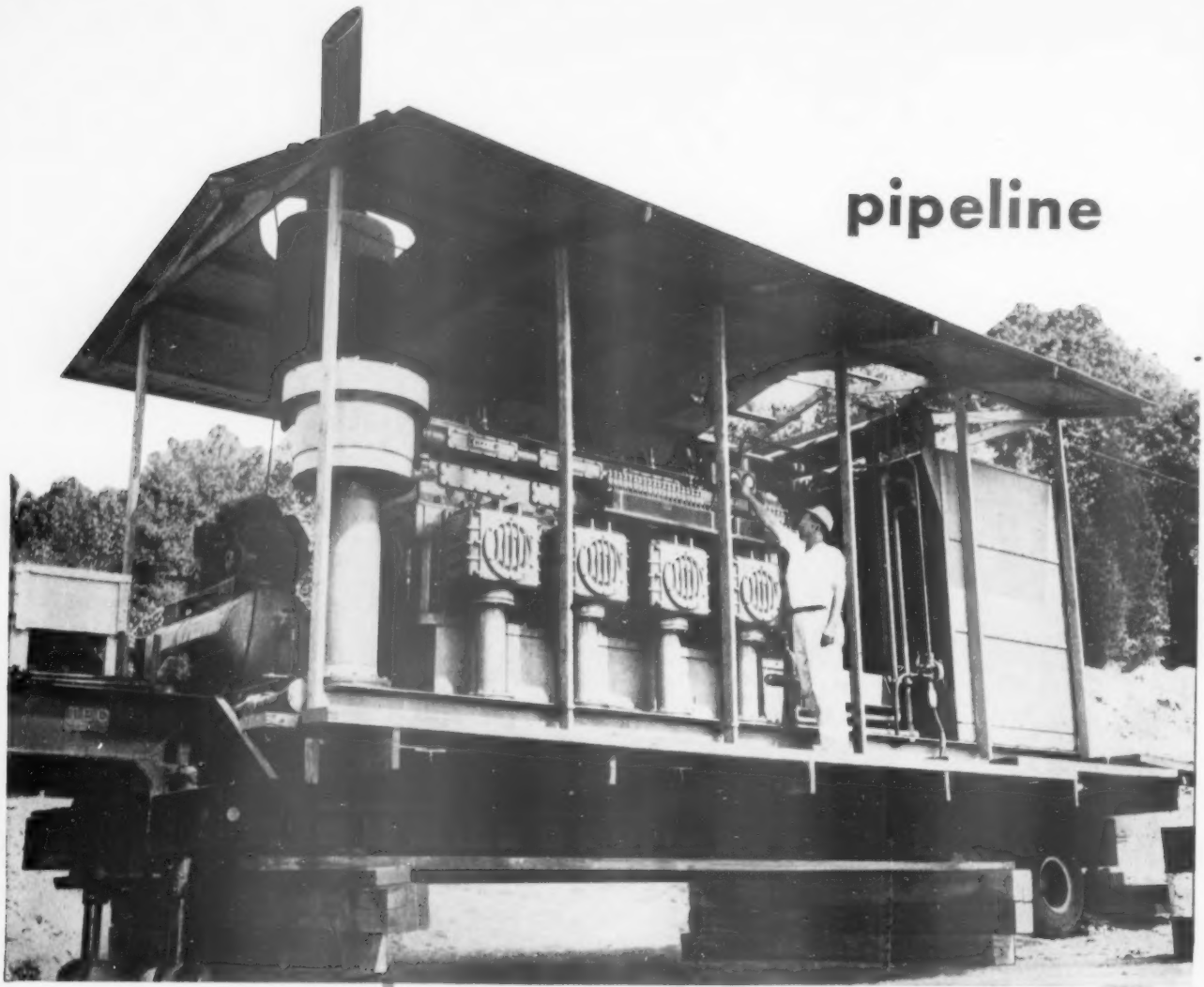
• *(Tubing Specialties)*

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S NATIONAL SEAMLESS PIPE AND TUBES

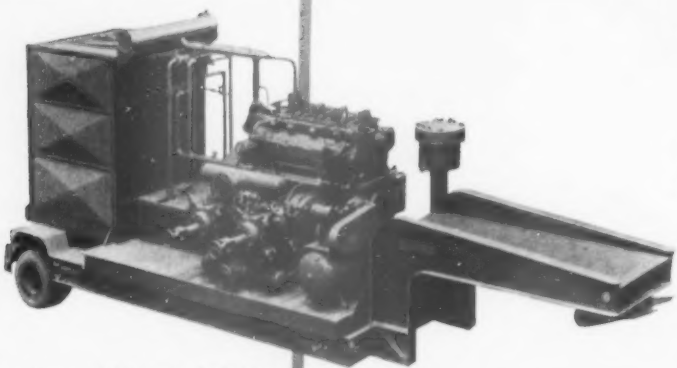
UNITED STATES STEEL

pipeline

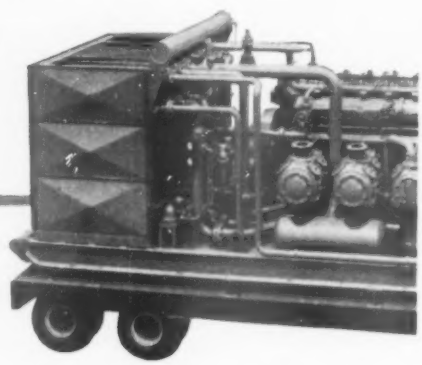


Clark Trailer-Mounted, HMA-8, 350 bhp, "Midget Angle" testing an Eastern U. S. pipeline at 800 psi. Temporary blocking used because of soft ground conditions.

Clark Trailer-Mounted HMA-8, 350 bhp, "Midget Angle" for operation at 800 psi discharge.



Clark Trailer-Mounted HMA-4, 175 bhp, "Midget Angle" for operation at 530 psi discharge.



testing completed weeks ahead

with CLARK "MIDGET ANGLES"

Whether you're building completely new lines, looping old ones or considering operating old ones at higher pressures, the job of testing can best be handled with a trailer-mounted Clark "Midget Angle."

At the capacities needed, a "Midget Angle" uses substantially less fuel, requires less personnel and less maintenance than a group of smaller units. It operates on bottled propane, or natural gas from an adjoining pipeline where lines are being looped.

Because of its Balanced/Opposed design, the "Midget Angle" easily operates on a trailer without being tied or bolted down. *There is no vibration.*

Its narrow width (8 ft. 9 in.) permits transportation on average roads without disassembly. Less time is consumed in moving from one testing point to the next. There is only one unit to haul.

When not engaged in testing, the Clark "Midget Angle" trailer-mounted compressor can be used or leased out to supply compressed air on other large construction projects.

Four, six and eight-cylinder units are currently operating in this type of service, with outstanding success, in various sections of the country . . . *getting the testing job done weeks ahead of schedule.* For complete details on Clark "Midget Angle" factory-packaged compressors, write for Bulletin 126.

CLARK BROS. CO. • OLEAN, N. Y.

DIVISION OF DRESSER OPERATIONS, INC.

SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

PRECISION BY THE TON

CLARK compressors

MOTOR DRIVEN • GAS, STEAM OR DIESEL ENGINE DRIVEN • CENTRIFUGAL • AXIAL FLOW

© 1953, Clark Bros. Co., Division of Dresser Operations, Inc.

YOU

HAVE HELPED *Lufkin* ENGINEERS DEVELOP THE FINEST EQUIPMENT IN THE FIELD TODAY!

The success of this company is due, in a large measure, to the assistance of its many friends in the Oil Industry.

Constructive criticism, the cooperation and help toward the improvement of our product has been of real assistance to us and has in turn been a contribution toward the advancement of Modern Production Equipment.

We acknowledge the assistance of our many friends and to those who have had a part in this development we express our keenest appreciation.

30 Years Experience

IN DEVELOPING AND BUILDING OVER 40,000 PUMPING UNITS HAVE MADE

LUFKIN

THE SYMBOL OF *Top Quality*

Lufkin **FOUNDRY & MACHINE COMPANY**

LUFKIN, TEXAS

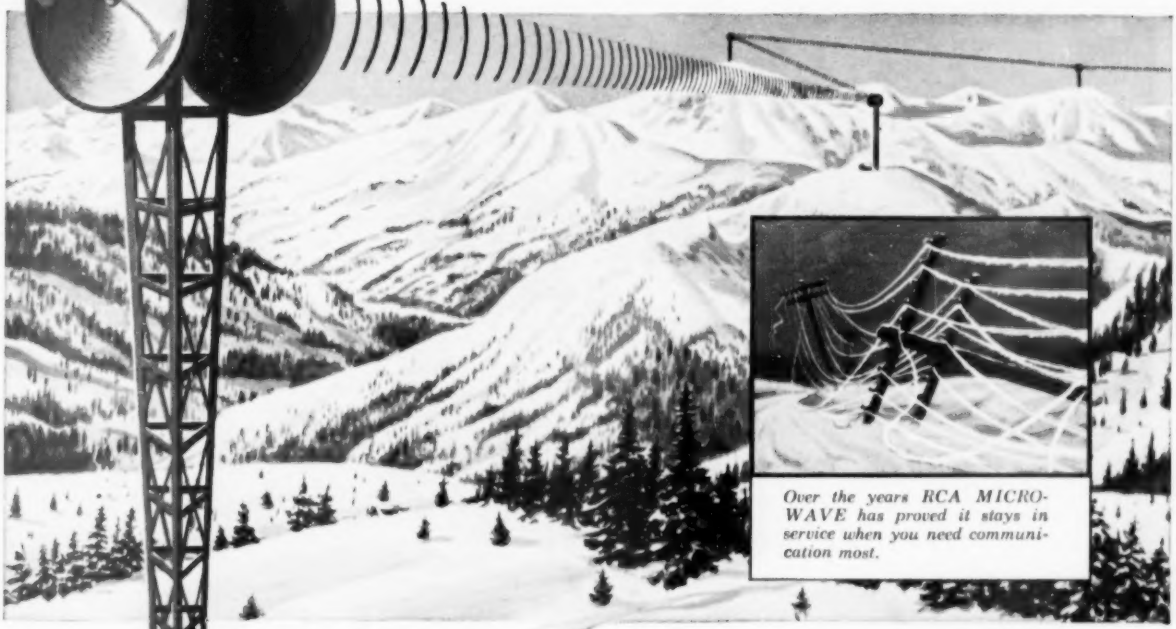
Branch sales and service Houston, Dallas, New York, Tulsa, Los Angeles, Seminole, Oklahoma City, Corpus Christi, Odessa, Kilgore, Wichita Falls, Casper, Wyoming, Great Bend, Kansas.

Lufkin Equipment in CANADA is handled by

THE LUFKIN MACHINE CO., LTD., 14321 108th Avenue, Edmonton, Alberta, Canada.

RCA MICROWAVE

RADIO-RELAY COMMUNICATION AND REMOTE CONTROL



Over the years RCA MICROWAVE has proved it stays in service when you need communication most.

Most practical system, most complete service

RCA Microwave gives you as many voice channels as you need with minimum use of frequency space. It employs conventional tubes; familiar circuits not difficult to service. It interconnects with your telephone lines and switchboards.

Over the years the operating records of RCA MICROWAVE systems reveal a long history of successful operation through every kind of weather. Numerous RCA installations are now providing continuity of service in many applications.

RCA survey, construction and installation facilities are a complete, single-source, single-responsibility service.

For speedy, economical communication and for adequate, remote supervision, contact your local RCA Regional Office for information, or *mail coupon below.*

For dependable mobile communications, use *RCA 2-Way Radio.*

And remember, only RCA can provide the nation-wide service facilities of the RCA Service Company.

RADIO CORPORATION of AMERICA
COMMUNICATIONS EQUIPMENT **CAMDEN, N. J.**

Radio Corporation of America
Communications Division
Dept. 89UC, Building 15-1
Camden, N. J.

Please send me your new, free booklet on:

- ☐ RCA Microwave
- ☐ RCA 2-Way Radio

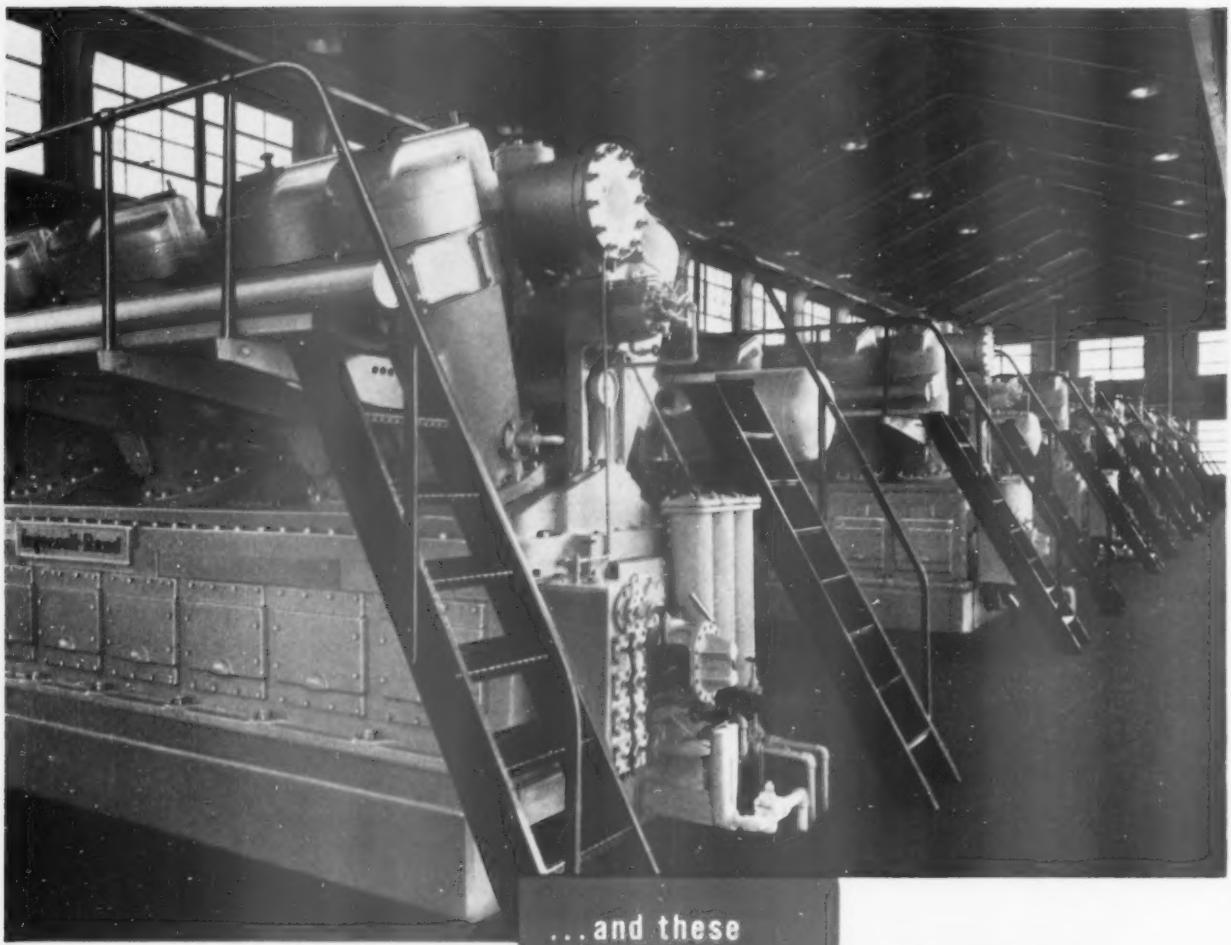
Name_____

Title_____ Company_____

Address_____

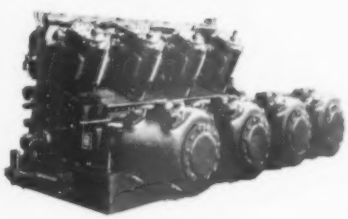
City_____ Zone_____ State_____

TWELVE I-R KVG GAS-

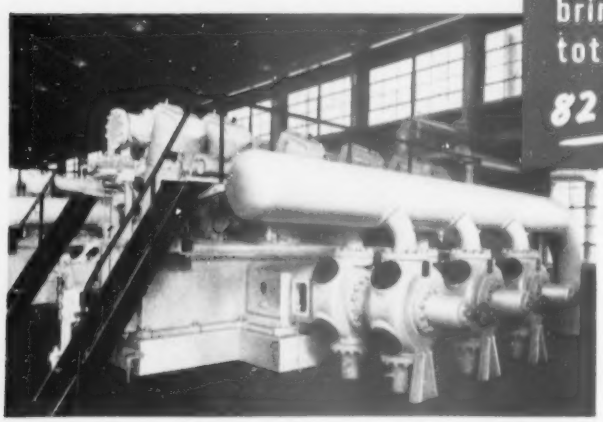


Six Ingersoll-Rand KVG gas-engine-driven compressors installed at United Gas Pipe Line Company's new Needville, Texas, gas booster station. These 1320-hp units boost gas pressure to 900 psig on a new 30-inch line.

...and these OTHER I-R compressors and gas engines bring United's total to *82 MACHINES!*



35 XVG's



Another view of the six KVG compressors at United Gas Pipe Line Company's Needville Station showing the compressor cylinders. This installation is duplicated at the Goodrich station.

COMPRESSORS • DIESEL AND GAS ENGINES

ENGINE-DRIVEN COMPRESSORS

add 15,840 hp to rapidly expanding natural gas system of

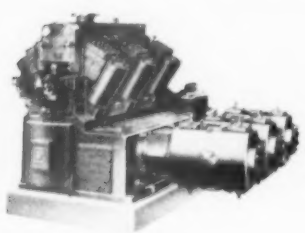
United Gas Pipe Line Company

It is a privilege to serve those who serve the Nation. Hence Ingersoll-Rand takes justifiable pride in the recent installation of twelve KVG gas-engine-driven compressors by the largest handler of natural gas in the world. These 1320-hp units, installed in booster stations at Needville & Goodrich, compress natural gas to 900 psig on a new 30-inch line – part of United's continuing program of system expansion.

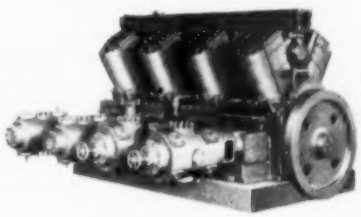
Ingersoll-Rand equipment is well known to operators throughout the entire United Gas Pipe Line system. For United has been using I-R compressors and engines for the past sixteen years.

The first of the famous XVG compressors were installed in 1937. Subsequent installations brought United's total to thirty-five of these XVG units – the original V-angle design pioneered by Ingersoll-Rand. Also included on the United Gas Pipe Line system are twenty-three of the newly-acclaimed JVG and SVG compressors, superseding the original XVG design – fourteen JVG units in 110, 165 and 220 hp sizes, and nine SVG units in 330 and 440 sizes. In addition, twelve 408-hp PVG gas engines have been installed for serving their pipe line stations.

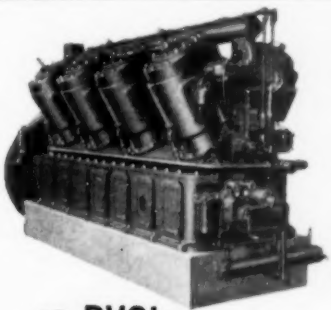
All of these compressors and gas engines are now in operation, giving the continuous dependable service for which I-R equipment has become traditional throughout the gas industry. Your nearest Ingersoll-Rand representative will be glad to give you complete information on I-R V Four-Cycle gas-engine-driven compressors in any type or capacity.



14 JVG's



9 SVG's



12 PVG's

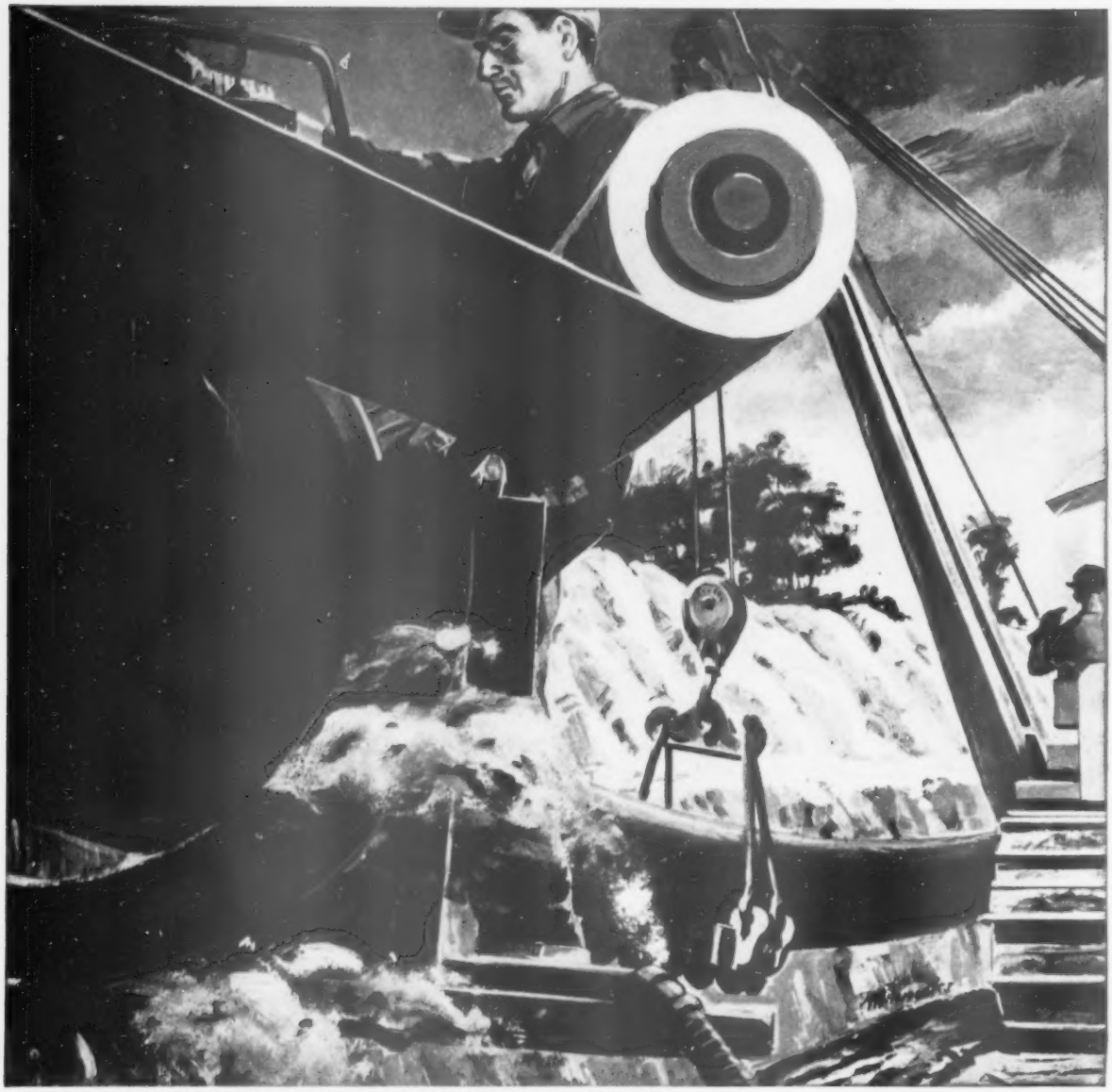
956-6

4 CYCLE V

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

• AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CENTRIFUGAL PUMPS • CONDENSERS



TEMPERA PAINTING BY JAMES MINNICKS ESPECIALLY FOR BARRETT DIVISION

Wrapping up the job

This scene, with the circling arms of the wrapping machine busily binding pipe with a tarred felt wrapper, is familiar to pipeliners. And members of Barrett's Technical Service Corps are an important part of the picture.

These trained men are paid by Barrett to work with **you!** They start when your pipeline job is in the planning stage, helping to determine the best protective coating to meet your specific needs and requirements. Therefore, you are assured in advance that costly pipe will **get** superior protection — to **give** longer service.

And Barrett Service Representatives are at your pipeline site whenever needed. The proper application of coal-tar enamels is vital —and a Barrett inspector's advice and supervisory experience can save you time and money. It is for this service that Barrett maintains field offices throughout the country.

For the best in pipe protection, at lowest cost . . . Specify Barrett — from **start** to **finish!**

Barrett®

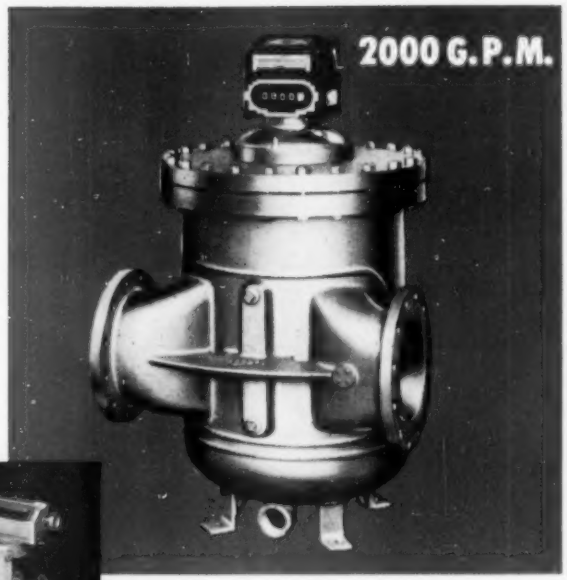
BARRETT DIVISION

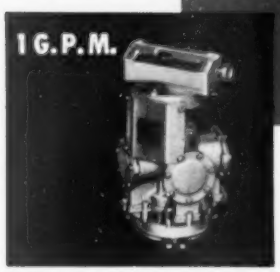
Allied Chemical & Dye Corporation

40 Rector Street, New York 6, N. Y.

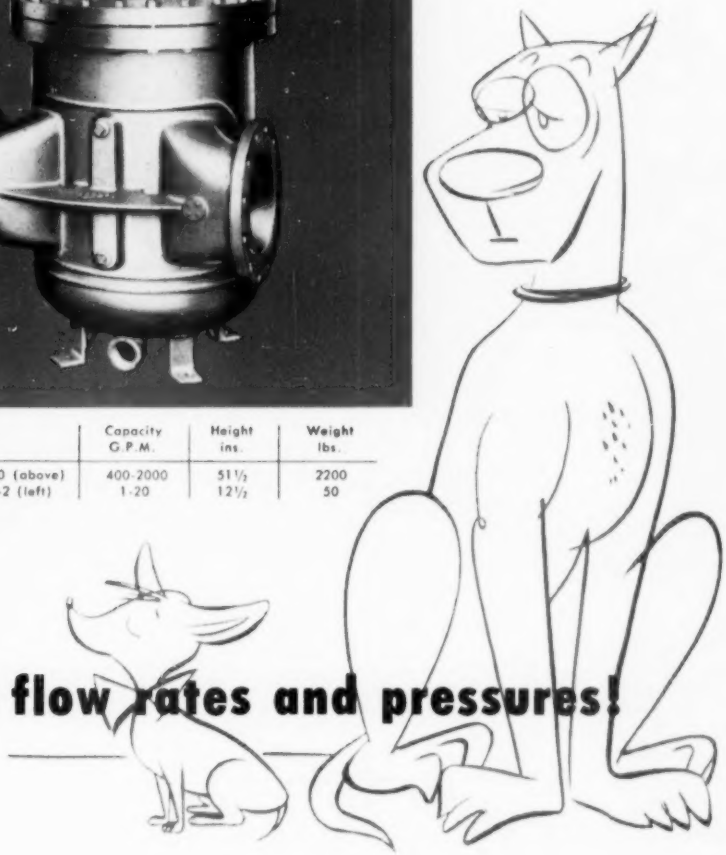
*Reg. U. S. Pat. Off.

In Canada:
The Barrett Company, Ltd., 5551 St. Hubert Street, Montreal, Que.





	Capacity G.P.M.	Height ins.	Weight lbs.
B-200 (above)	400-2000	51½	2200
APM-2 (left)	1-20	12½	50



WIDEST RANGE of flow rates and pressures!

Yes, A. O. SMITH offers you the widest range — flow rates from 1 G.P.M.; pressures to 2000 P.S.I. Types and sizes for every step of petroleum measurement from well to consumer. All are known for *sustained* accuracy, long life, dependability, lowest maintenance cost, ease of installation and service. Most complete line of *functional* accessories, too. See nearest representative or write A. O. Smith Corporation, Meter Division, 5715 SMITHway St., Los Angeles 22, California.

79th YEAR 1874 - 1953

A.O.Smith

METER DIVISION

FACTORIES: 5715 SMITHway STREET, LOS ANGELES 22, CALIFORNIA. P. O. BOX 500, SUSQUEHANNA, NEW JERSEY
Offices: Atlanta, Chicago 7, Houston 20, Los Angeles 22, New York 17
Canada: Toronto 12, Vancouver 1. International Div.— Milwaukee 1, Wisc.

You're sure of UNIFORM HIGH QUALITY

SEAMLESS • PRESSURE • MECHANICAL

CARBON STEEL TUBES

when you specify GLOBE

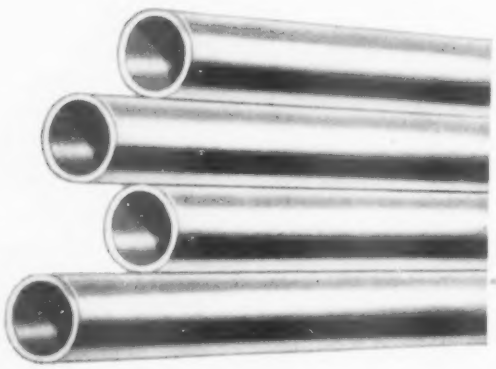
SIZE RANGE — WALL THICKNESS

Globe seamless carbon steel tubes are available in a size range of ½ inch to 7½ inches O.D.; wall thickness of .028 to 1.000 inch.

APPLICATIONS

Globe Pressure Tubes are used for boilers, condensers, heat exchangers and process equipment. They meet most exacting demands of modern high pressure and high temperature installations. Globe Mechanical Tubing (seamless) is produced by piercing solid billets. It is an ideal material for low-bearing structural members and parts where strength with minimum weight is needed. Its economy for the manufacturing of many machine parts is universally recognized.

Globe seamless carbon steel tubes are furnished to standard specifications in low and medium carbon ranges.



WHEN you specify Globe you are sure of uniform high quality carbon steel tubes. That's because they are the product of highly developed production facilities and specialized quality controls and methods.

Globe engineers are at your service to assist in the selection of tubing of the exact characteristics you require.

GLOBE TUBES

GLOBE

STEEL TUBES CO.

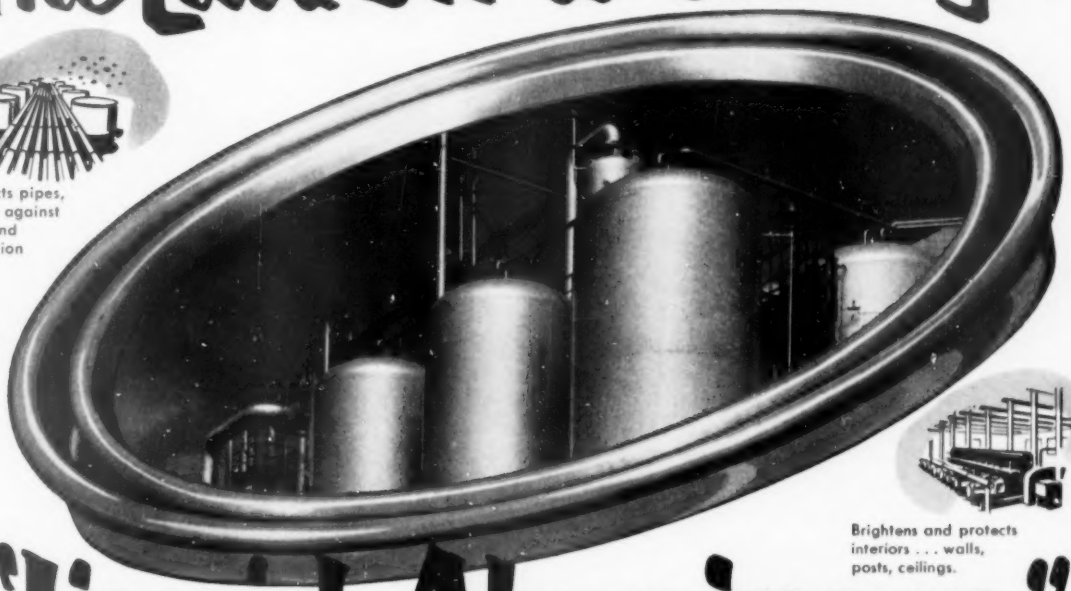
MILWAUKEE 46, WISCONSIN

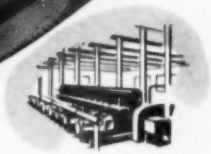
Chicago • Cleveland • Philadelphia • St. Louis • New York • Detroit • Denver • Houston • San Francisco
Glendale, Calif.

Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — alloy-carbon seamless steel tubes — Globeiron (high purity ingot-iron) seamless tubes — Globe welding fittings.

The Lid's Off to Savings-

Protects pipes, tanks, against rust and corrosion





Brightens and protects interiors . . . walls, posts, ceilings.

"Liquid Aluminum" is Here!

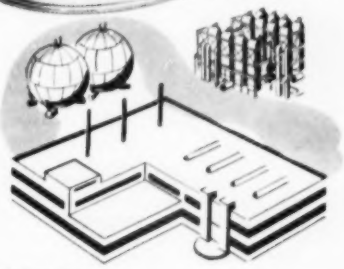
Improves appearance . . . minimizes expansion and evaporation problems

It's the petroleum industry's most protective and most beautiful coating inside or outside! Sparkling *Liquid Aluminum* is amazingly resistant to money-eating rust . . . resists corrosion from smoke and fumes, too. It reflects up to 85% of heat and light rays . . . reduces evaporation losses . . . minimizes expansion and contraction problems . . . makes plant interiors brighter.

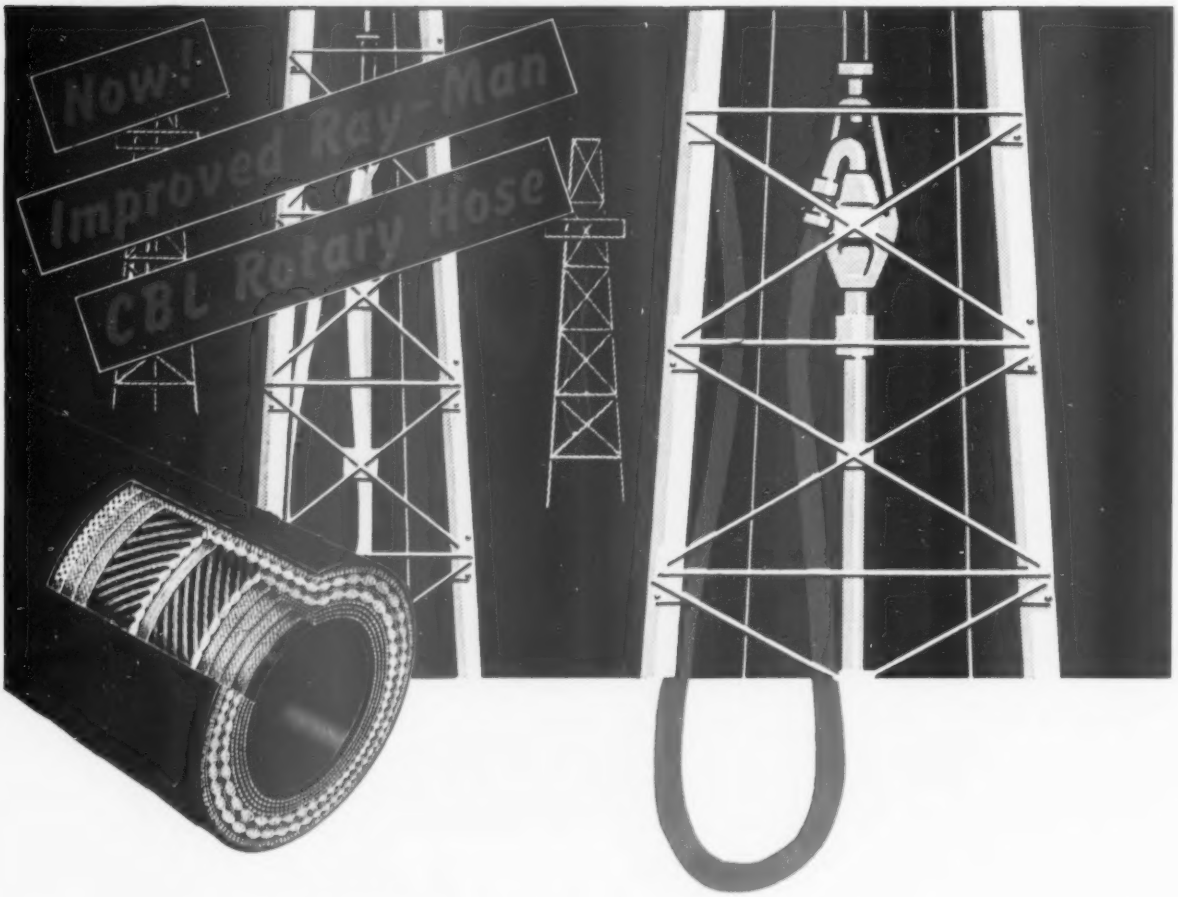
Look for the Liquid Aluminum label on the aluminum paint you choose. It is made to approved minimum standards by leading paint manufacturers. Ask your paint supplier or write for names of manufacturers to Reynolds Metals Company, 2595 So. Third St., Louisville 1, Ky.

. . . And for economical, lasting, one-coat protection for your built-up or rustable metal roofs

. . . look for this warranty and this label when you buy asphalt-aluminum roof paint or coating! *Liquid Aluminum* Roof Paint or Coating adds years to roof life—reflects harmful sun rays . . . protects against all kinds of weather. The *Liquid Aluminum* label and the special Warranty Seal are your assurance of quality. Write for folder with detailed information.



This advertisement appears in the interest of the Paint Industry of America.



FOR LOWER RIG COSTS . . . Special cable wire reinforcement is one of the important improvements in Ray-Man CBL Rotary Hose that makes it still *more* flexible—with a higher factor of safety. The Ray-Man method of winding high tensile steel cable strength members under precisioned tension permits rotary hose flexibility never before equaled. The new Ray-Man resists kinking and, if accidentally crushed, will come back to full roundness under pressure. It is strong and blow-out proof. Built-in coupling features the "Lip-Lok" seal that tightens under high pressure. Ray-Man is easier than ever to make up in the rig and field tests prove it will give you MORE USE PER DOLLAR.

DISTRIBUTED BY NATIONAL SUPPLY COMPANY IN ALL PRINCIPAL OIL FIELDS

Write for Catalog 6903, describing Raybestos-Manhattan's full line for the oil industry; hose, V-belts, transmission belts, brake lining and packing.

R/M

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

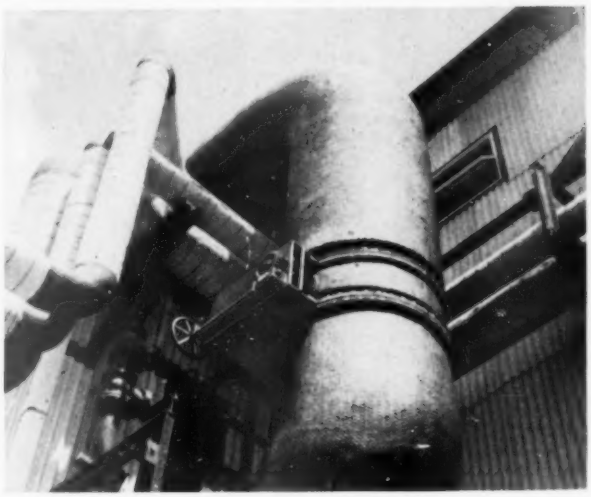
RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings
Asbestos Textiles • Teflon Products • Packings • Sintered Metal Parts • Bowling Balls

MR 915

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



R-S VALVES OPERATE EASILY

Above or Below Floor Level

Because of their comparative light weight and minimum space requirements, R-S Valves are particularly well adapted for installation at considerable heights above the floor level. In such positions they are usually operated manually by chainlever, chainwheel, extended reach rod or controlled automatically.

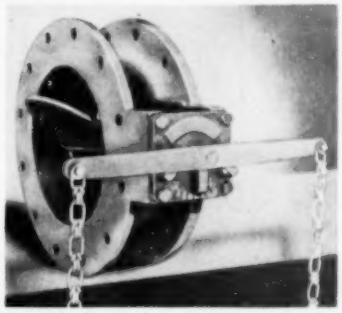
Where the valve must be installed in an inaccessible position below the floor level, a floor stand is provided. Control is just as quick and uniform as in those installations where the handwheel is mounted directly on the valve shaft.

Simplicity of design, the wide range of application and ease of operation indicate the high order of metallurgical and mechanical engineering that is embodied in every R-S Valve.

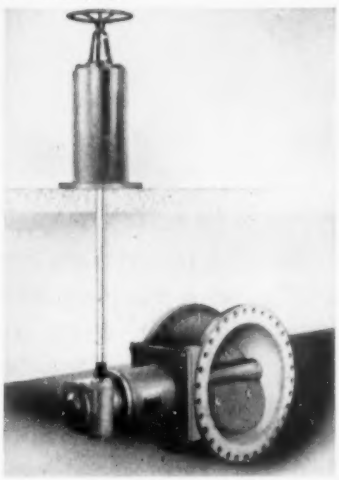
Consult your local R-S Valve Engineers, or write direct.

R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.

An S. Morgan Smith Company Subsidiary

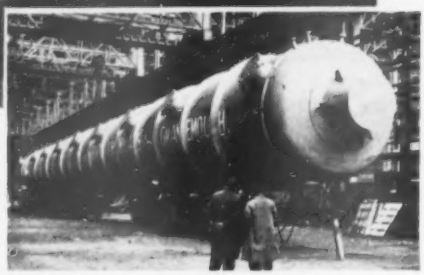


No. 688—Heavy duty chainlever valve for quick opening or closing in elevated and inaccessible locations. R-S Valves are used to control and shut-off the volume and pressure of nearly all materials in the temperature range from minus 300° to plus 2000° F. 2 to 2500 psig.



No. 788—Heavy duty valve equipped with rubber seat, totally enclosed gear reduction drive, extended shaft and floor stand. Positive shut-off is obtained up to 125 psig with rubber seated valves and commercially tight shut-off to even higher pressures with a babbitted seat.

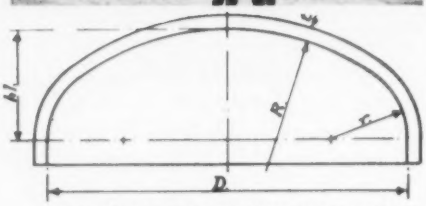
No. 839—8-inch heavy duty valve equipped with 125-pound flanges, 18-8 shafts, bronze bushings and a throttling type motor operator for the control of low pressure air.



SEMI-ELLIPSOIDAL HEADS are available, with varying knuckle radii and depth, in a wide range of sizes from 5′ 0″ inside diameter to a finished Head produced from a flat plate 18′ 0″ in diameter. Flat Flanged Ends for Boiler back and front plates are also a product of the "Rotarpress" plant. Yet another part of the "Harvey" service to Industry is the production of Die-pressed Dished and Flanged Ends varying in size from 6″ diameter up to 9′ 0″ diameter.

Manufactured to Lloyds Rules, A.O.T.C. and A.S.M.E. Codes in Mild Steel, Alloy Steels, Nickel, Nickel-clad, Stainless-clad, and Chrome-clad Steels up to 4″ in thickness.

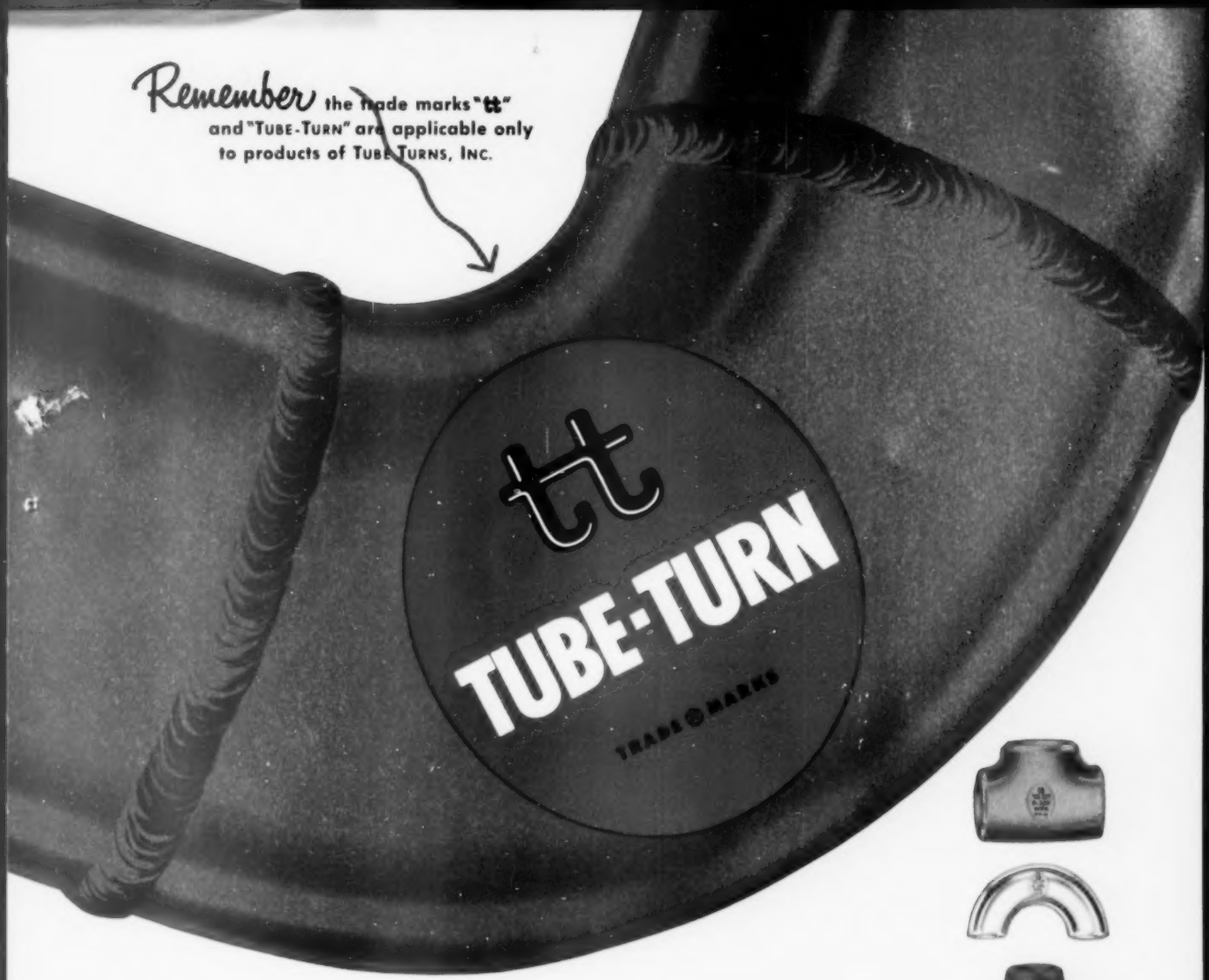
For full details and tables send for List OG 790.



STANDARD PROPORTIONED HEADS

D	R	r	h1	t. range
5′ 0″	4′ 0″	10″	15¼″	⅜″—4″
5′ 6″	4′ 6″	10″	16⅛″	⅜″—4″
6′ 0″	5′ 0″	12″	18 7/16″	⅜″—4″
6′ 6″	5′ 6″	12″	19⅛″	⅜″—4″
7′ 0″	6′ 0″	12″	20″	⅜″—4″
7′ 6″	6′ 6″	12″	20¾″	⅜″—4″
8′ 0″	6′ 6″	16½″	25⅛″	⅜″—3½″
8′ 6″	7′ 0″	16½″	26⅛″	⅜″—3½″
9′ 0″	7′ 6″	16½″	27″	⅜″—3½″
9′ 6″	7′ 6″	16½″	28½″	⅜″—3½″
10′ 0″	8′ 0″	16½″	29 7/16″	⅜″—3″
10′ 6″	8′ 0″	23″	35″	⅜″—3″
11′ 0″	9′ 0″	23″	34⅛″	⅜″—2½″
11′ 6″	10′ 0″	23″	34 7/16″	⅜″—2½″
12′ 0″	11′ 0″	23″	34⅛″	⅜″—2″
12′ 6″	11′ 0″	23″	36¼″	⅜″—2″

G. A. Harvey & Co. Harvey (London) Ltd. Woolwich Road, London S.E.7



Available in all piping materials!

ALLOY OR NON-FERROUS PIPING is often the answer to problems of contamination, corrosive action, severe pressures and temperatures, or cyclic operation. You can obtain TUBE-TURN Welding Fittings and Flanges of stainless steels, nickel and nickel-base alloys, copper and copper-base alloys, aluminum and aluminum-base alloys, and newest of all, titanium. For good service in welding fittings, in carbon steels, or in alloy or non-ferrous metals, call your nearby TUBE TURNS' Distributor. He's ready to serve you from industry's most complete line.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles • Denver • Atlanta • Dallas • Midland, Texas

Subsidiaries: TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO • PENNSYLVANIA FORGE CORPORATION, PHILADELPHIA, PA.

ENGINEERING SERVICE

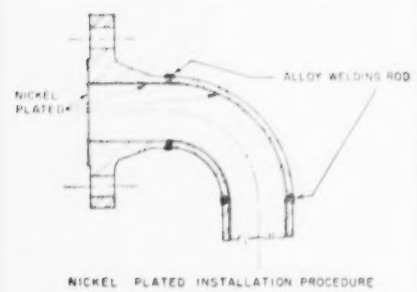
TUBE TURNS' *Engineering Service*

can help you cut cost of corrosion-resistant piping

G. A. GAUM is one of TUBE TURNS' Engineering Service Division men spending a great deal of time in the field obtaining performance data that contributes to improved piping technology.

THE COST of corrosion-resistant piping can often be minimized by the use of standard carbon steel piping *plated* on the inner surface with such materials as nickel, copper, etc. In atomic energy plants, nickel-plated piping in sizes through 42" is giving satisfactory service, and has substantially reduced original cost. The method is also applicable to many industrial processes where corrosion resistant materials are specified.

Such plating is generally .008" thick, and can be applied in heavier thicknesses where desirable. You can obtain recommendations on preferred plating sources, proper welding techniques and rods from TUBE TURNS' Engineering Service—always ready to help you with special piping problems.



NICKEL PLATED INSTALLATION PROCEDURE

Installation procedure for nickel plated welding fittings and flanges.

Building an aluminum gas line with TUBE-TURN Welding Fittings and Flanges. Design and installation are simplified by completeness of Tube Turns' line, permitting you to fill all requirements from one reliable source. Forged-in strength of TUBE-TURN Welding Fittings assures dependable, leakproof service.

Dimensional accuracy of TUBE-TURN Welding Fittings speeds fabrication in the shop or in the field. True circularity and uniform wall thickness assure perfect alignment. Each TUBE-TURN welding fitting is individually examined by skilled inspectors for accuracy.

Want Piping Information?

TUBE TURNS, INC. is recognized the world over for its leadership, not only in the field of welding fittings and flanges, but as a source of authentic information on piping design. Check the coupon below for bulletins you would like to receive.

TUBE TURNS, INC., Dept. J-9
224 East Broadway, Louisville 1, Kentucky

Please send me free copy of:

- ☐ Special Alloys
- ☐ Pipe and Fitting Materials
- ☐ Stainless Steel Welding Fittings and Flanges
- ☐ Design Properties of Pipe

Your Name _____

Address _____

City _____ *State* _____

Position _____ *Company* _____

DISTRICT OFFICES

New York	Tulsa
Philadelphia	San Francisco
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"TT" and "TUBE-TURN" Reg. U. S. Pat. Off.

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

Mack comes in costs go down

It happens all the time. A truck user finds that heavy loads, rigorous weather, or tough terrain are proving too much for the trucks he owns. Frequent breakdowns . . . interrupted output . . . excessive repairs—all conspire to boost his costs and cut his profit margin. Then—if he's smart—he switches to Mack six-wheelers.

And that's where he gets a real eye-opener. Because even under the most adverse hauling conditions—hub-deep mud, slippery sand or pitted rock-strewn ground—his Mack six-wheelers keep the big loads moving on dependable, time-saving, cost-cutting schedule.

The reason why? It's found in Mack's Balanced Bogie with exclusive Power Divider that assures positive traction no matter how tough the going. Acting normally as a true differential the Mack Power Divider delivers torque between the two bogie axles in proportion to wheel traction, thus eliminating useless wheel slippage and spinning.

Mack's Balanced Bogie and Power Divider combine with numerous other outstanding Mack features to give you the power, strength, traction and easy maintenance you need to handle the biggest loads—with greater profit to you. Your nearest Mack branch or distributor will gladly give you all the facts.

Mack TRUCKS

. . . outlast them all

Mack Trucks, Empire State Building, New York 1, N. Y. Factory branches and distributors in all principal cities for service and parts. In Canada: Mack Trucks of Canada, Ltd.

Throughout the oilfields, Mack 6-wheel trucks get the call for tough hauling jobs. Owned by Heard & Heard, Inc., Refugio, Texas, Mack Model LMSW-X is shown taking aboard a mud pump.

FISHER

TYPE 1305 ANTI-FREEZE REGULATOR

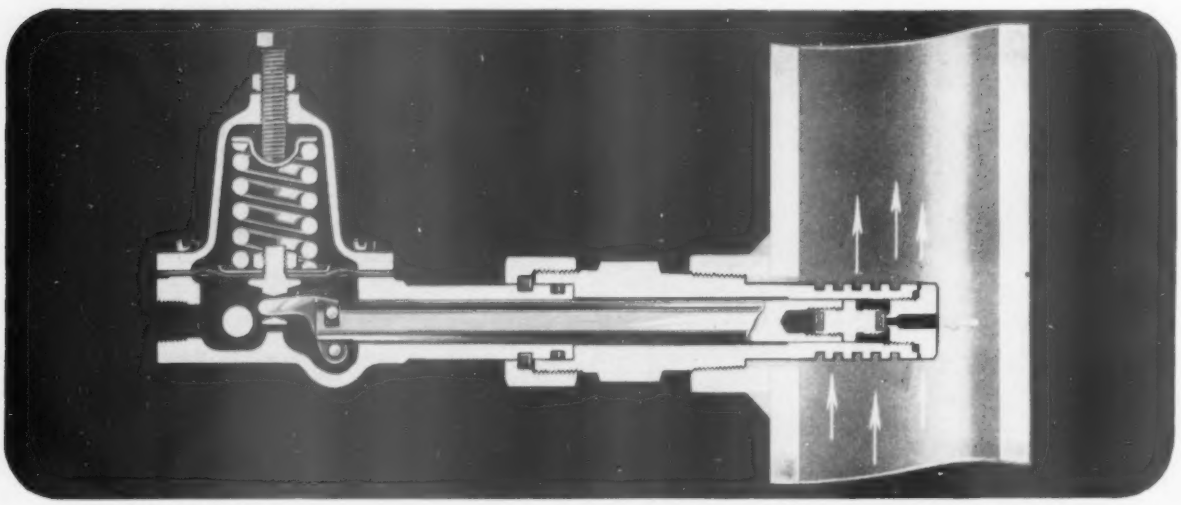
MINIMIZES

Freeze Up

PROBLEMS

The Type 1305 is an anti-freeze regulator for use when a pilot operating medium or similar minor flow is required. The inlet is installed *directly* in the warm gas flow line. Heat from this flowing gas is transmitted to the low or reduced pressure gas through the fins on the inlet adaptor, thereby raising temperature of reduced pressure gas and regulator body to *prevent hydrate formation conditions* which result in regulator freeze-up.

Inlet Pipe Connection—1"—11—½ NPT.
Outlet Pipe Connections—¼"—18 NPT.
Pressure range
Maximum body pressure 3000 psi.
(Special—4000 psi with 1/16" orifice).
Reduced pressure ranges 10-225 psi.
Capacity—Up to 10 CFM.



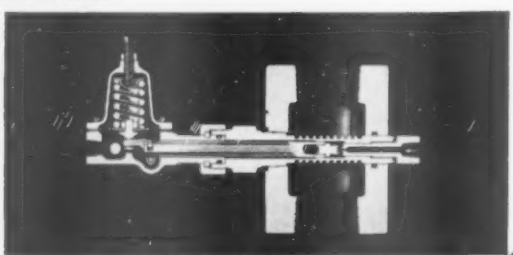
FEATURES:

1. Reversible double disc holder provides an extra valve disc.

2. Body has second outlet for relief valve or gauge connection.

3. Sturdy, reliable construction utilizing brass castings and forgings.

4. Regulator is easy to install and simple to disassemble.



. . . and the companion Type 1306 for use on oil lines.

Utilizes either flowing oil or oil and gas mixtures from well head for heat source to regulator body at point of gas reduction or pressure breakdown. *Gas source must be from separator or accumulator.*

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

WORLD LEADER IN RESEARCH FOR BETTER LIQUID LEVEL AND PRESSURE CONTROL

FISHER *Since 1880*

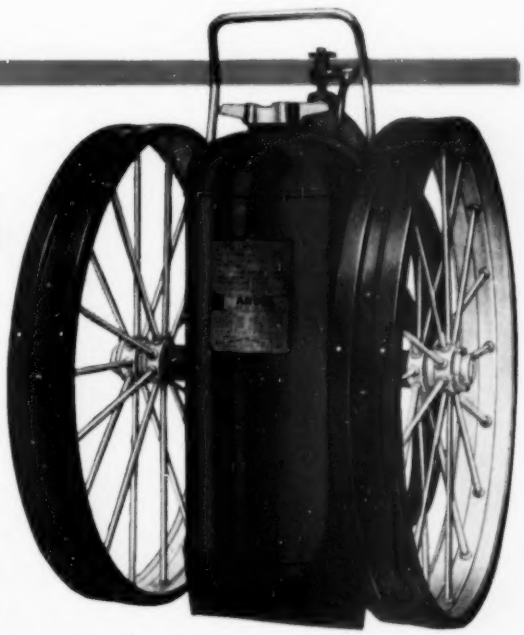
NEW

ANSUL WHEELED FIRE EXTINGUISHERS *provide*

MODEL 150-B

Rubber tires optional equipment

. . . GREATER FIRE-KILLING CAPACITY . . . HIGH-SPEED OPERATION and EASIER MANEUVERABILITY . . .



MODEL 350-B

Ansul "B" Model Wheeled Extinguishers are completely new. Dozens of design changes have improved their operating characteristics as well as their appearance. They provide faster, easier extinguishment of fires almost twice as large as those handled by our "A" model wheeled extinguishers. New Ansul Wheeled Extinguishers are easier to move to the fire. They can be actuated faster. They'll put out more fire faster. They're easier to recharge and maintain. And they will give even more years of trouble-free service.

For a demonstration call your Ansul representative today. Or for additional information send for file number *W-25*.

ANSUL *Chemical Company*

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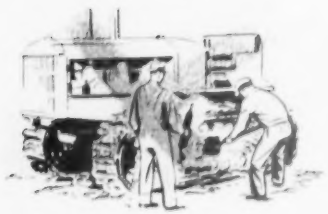
MANUFACTURERS OF DRY CHEMICAL FIRE EXTINGUISHING EQUIPMENT, REFRIGERATION PRODUCTS, INDUSTRIAL AND FINE CHEMICALS AND LIQUEFIED GASES

Advance design features make Allis-Chalmers Tractors performance leaders

It takes truly modern equipment to keep pace with today's stepped-up demands — and do it at an operating cost which insures fair and consistent profits. The line of Allis-Chalmers crawler tractors has been designed and built completely new since the war, with the kind of advanced engineering that delivers big-capacity performance at a minimum of maintenance expense.

This forward progress is a continuing program. Additional improvements are constantly being incorporated into the HD-5, HD-9, HD-15 and HD-20 tractors. If you are in the market or just interested, see your Allis-Chalmers dealer for all the inside facts that have proved so popular with owners as well as operators and mechanics.

1000-hour Lubrication



Daily Lubrication

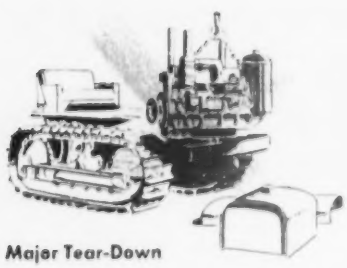
On all Allis-Chalmers tractors, you can operate six months on a 40-hour week basis with just one lubrication of truck wheels, front idlers and support rollers. Designed with positive seals and tapered roller bearings, these units are protected from dust, loose sand, soft ground, mud or water. You not only gain working time, but save labor and lubricant costs as well. And there's no costly damage from greasing neglect.

Hydraulic Steering and Self-Energizing Brakes

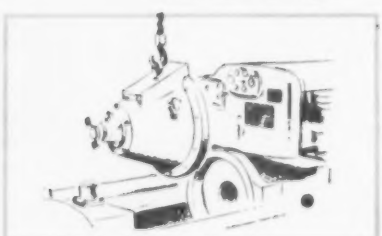
Ordinary Steering Clutches

Allis-Chalmers HD-15 and HD-20 tractors are equipped with fingertip hydraulic booster steering — operator exerts only 3 to 5 lb. pressure on the controls. As a result he gets small tractor maneuverability from these 27,850 and 41,000-lb. crawlers and can concentrate on his work. All four models are equipped with self-energizing brakes. These require less pedal pressure and take hold with a firm, uniform grip for accurate control.

Unit Servicing

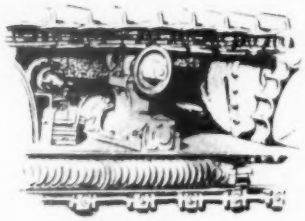


Major Tear-Down

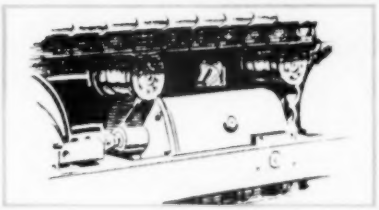


No need to remove transmission or engine, radiator, grille, etc., when servicing or removing an Allis-Chalmers master clutch. The unit assembly principle also applies to final drive gear, transmission, steering clutches, engine and truck frame. As a result, hours of costly service and down time are saved because of Allis-Chalmers advanced design.

Oil Enclosed Track Release Mechanism

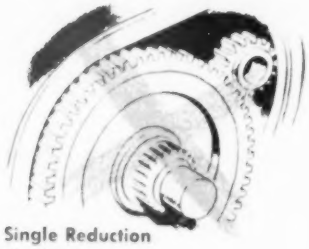


Open or Partly Shielded
Track Release Mechanism



Operating in oil and *sealed* against dirt and moisture, the Allis-Chalmers track release mechanism seals out mud, ice and debris. Because it's completely sealed, the release mechanism is in working condition at all times — providing positive protection when obstacles jam into the tracks.

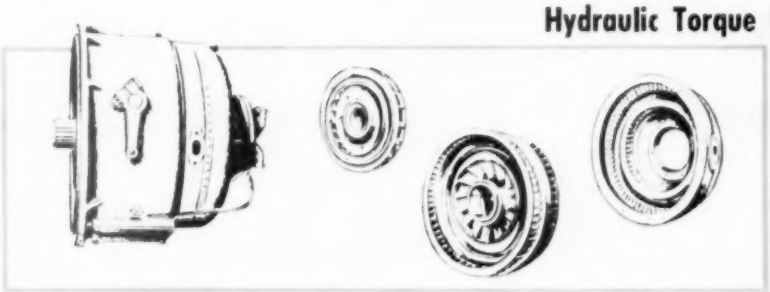
Double Reduction Final Drive



Single Reduction
Final Drive

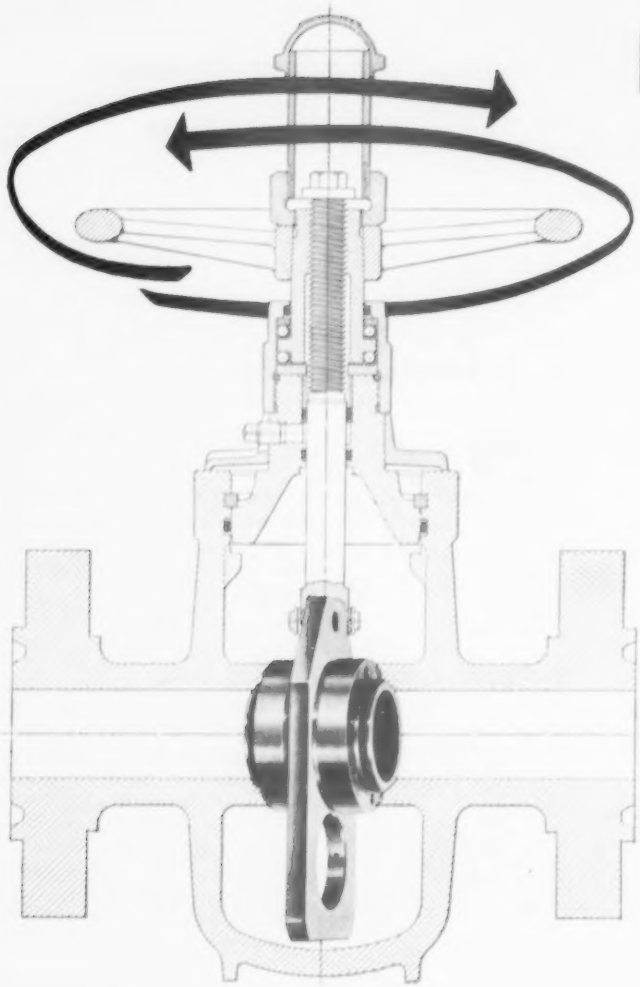
With smaller gears and shorter shafts, double reduction final drives provide better bearing and gear alignment. The "live" axle permits smaller, more serviceable seals. Equally important, double reduction drive provides for smooth, clean bottom construction and the extra ground clearance so necessary on rough terrain.

Hydraulic Torque Converter Drive



The Allis-Chalmers HD-20 is the only crawler tractor in the industry where torque converter is standard equipment and part of the tractor's basic design. With torque converter there is greater pay load capacity because this unit automatically balances travel speed to the load — no idle horsepower, no worry about engine stalling. And with most shifting eliminated, there's far less operator fatigue.

ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.

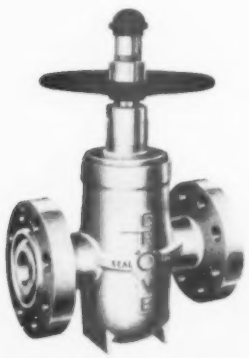


LOWEST TORQUE
—opening and closing

—with smooth sliding action

- NON-WEDGING
- SELF-ALIGNING
- SELF-CLEANING
- MINIMUM FRICTION

Grove SEAL-"O"-RING Gate Valves utilize a solid sliding parallel-faced port plate that is non-wedging, non-distorting, fully self-aligning. There is no galling, sticking or freezing. Operating mechanism is permanently free acting, with lifetime lubricated ball bearings and stem threads completely protected from line fluids and weather. The coefficient of friction, both static and kinetic, is so low in Grove SEAL-"O"-RING Valves as to insure easiest operation—opening or closing. Torque necessary to turn the operating wheel is far less than required for any other type of gate valve. You never have to crowbar or hammer the wheel to unseat or close. For dependable long service with low maintenance, investigate Grove SEAL-"O"-RING Valves today.



Streamlined inside and out in a broad range of sizes for production and pipe line services

For fully descriptive bulletin No. G-53, write or wire today

Available through leading oil field supply stores.

GROVE SEAL-"O"-RING Gate Valves

GROVE REGULATOR COMPANY • 65th & Hollis Sts., Oakland 8, California

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GROVE SIMPLICITY ACCURACY SAFETY

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the six-foot starter

...puts you miles ahead!

The Gardner-Denver Twindril sinks six feet of hole with the starting steel. Or an 8-foot starter can be used when necessary.

That just about eliminates steel-changing time from pipe line drilling—another reason why the fast-stepping Twindril helps you open a rocky trench miles ahead of your pipe-laying crews. Send for Bulletin WD-1.

SINCE 1859

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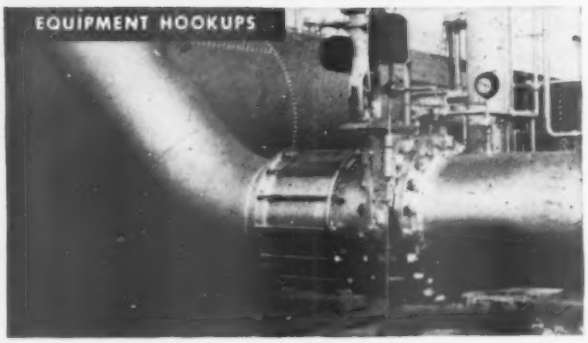
IN THE OILFIELDS . . .

the DRESSER way is *easier . . . surer!*



As an oilman, you're interested in joining pipe quickly . . . maintaining tight joints . . . making fast repairs with minimum losses and shutdowns. Using Dresser Couplings and repair products, you can do just that.

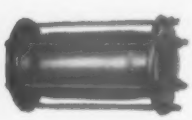
Dresser Couplings or Long Sleeves go together simply and quickly. Resilient Dresser Gaskets assure flexible joints which absorb settlement, other movement . . . on well and separator piping . . . salt-water lines . . . tank, pump, engine and compressor connections.

When a split, break or leaking joint occurs, Dresser Clamps and Sleeves turn an emergency into a simple repair job—completed in a matter of minutes *without shutdowns.*

You'll find there's a Dresser product for every condition and requirement affecting oilfield pipe lines, and that the DRESSER way is *always* easier, surer.

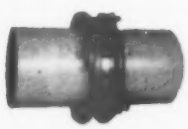
AVAILABLE AT ALL LEADING OILFIELD SUPPLY STORES

Style 38
Coupling


Style 40
Long Sleeve

Style 63
Expansion Joint

Style 39
Insulating Coupling


Style 55
Perous Weld Clamp

ALSO COLLAR LEAK CLAMPS, HIGH PRESSURE REPAIR SLEEVES

DRESSER®

COUPLINGS

Dresser Manufacturing Division, 49 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Bayshore Highway, South San Francisco, California.

2 Headline Attractions in PIPELINE CONSTRUCTION

The new Type 49 WALWORTH Gate Valve

Sizes 2" to 30"

- ★ Through-port design; body and disc ports accurately indexed and the body ports bored to match the pipe.
- ★ No recesses, no obstructions.
- ★ Stellite-faced seat rings.
- ★ Walworth boltless design body-to-bonnet joint.
- ★ May be installed without regard to flow direction.
- ★ No internal lubrication needed.
- ★ Incorporates 111 years of Walworth experience in the manufacture of bronze, iron, and steel valves.

MIDWEST Welding Fittings

Many welding fittings were first offered by Midwest, and highly desirable exclusive features have been developed over a period of more than 22 years. The Midwest line of welding elbows is the most varied on the market. Midwest is an honored name with pipeline companies, engineers, and contractors.

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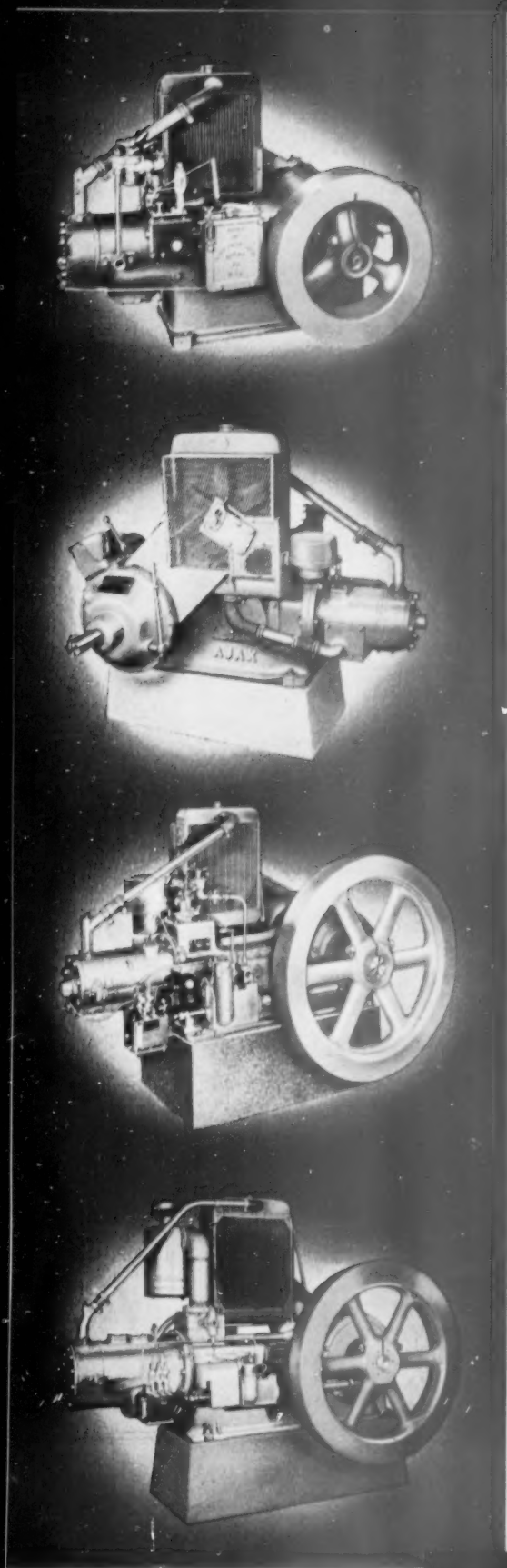
PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION
PARTNERS IN PETROLEUM PROGRESS



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The versatile Ajax Engine line lets you choose the *right* gas or oil unit for your individual pumping needs. From the compact, sturdy 5" x 6½" Model WL, through the 6½" x 8", 7¼" x 8", 7½" x 10" and 8½" x 10" CMA engines to the big, heavy 11" x 14" CMD and 13¼" x 16" CMC units, you have a range of choice covering all pumping requirements of the various fields. ● Your Supply Man will gladly detail these leading engines for you—call him!

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AJAX IRON WORKS

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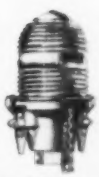

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Type FCB-12 Fresnel Beacon

Type TSS Flashing Switch

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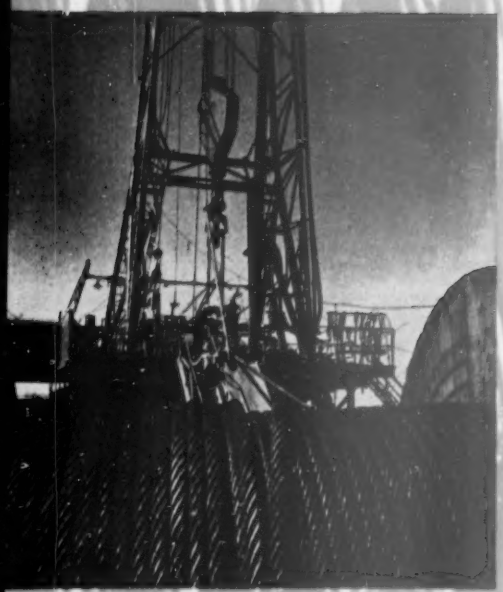
"...got 17 Wells off our last STANDARD Tuffy Rotary Line"

Says Drilling Company Owner in the Kansas Fields (name on request)



Jackknife Tuffy ROTARY LINES

specially designed . . . spools and reeves better on smaller sheaves and drums of the jackknife rigs. For deeper drilling with jackknife rigs, we recommend Tuffy *Standard* Rotary Line.

TON MILE RECORDS show Tuffy

Lasts Longer... Cuts Rope Costs

When rig owners and tool pushers ask how Tuffy can give such outstanding service records, there's only one answer: — because Tuffy Standard Rotary Line is specially designed for use with standard rigs!

Tuffy is made of special steels, specially constructed for extra strength and flexibility to run over standard rig sheaves and drums. It has higher resistance to abrasion, shock loads, drum crushing and internal friction. That's why Tuffy can give you more ton miles of service at greater savings!

Put Tuffy to the test on your next job—then compare its ton-mile service with other ropes you have used. You may be amazed how much you are saving on Tuffy's longer service life.

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IT'S EASY TO ORDER

Tuffy ROTARY LINES

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Now You Can Avoid Wasting or Overloading Lines with This FREE TON MILE INDICATOR

By measuring the work your line has done, you can quickly establish the correct cut off time for each hole and avoid wasteful cutting or overloading. That is what this FREE Union Wire Ton Mile Indicator does for you. Simply set the figures from your well log book on the indicator and read the ton mileage. All the complicated figuring is done automatically.

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- Cut-Off Procedures
- Servicing Drilled Wells
- Rigs & Ropes Used in Well Drilling
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Johnston Testers has successfully perfected a circulating valve and procedure for reverse circulating out the recovery on drill stem tests.

The Johnston (Sleeve Type) Circulating Valve has been proven in almost every type of well and under most conceivable conditions. Reverse circulating with the Johnston valve can be generally recommended if the hole will stand testing.

ECONOMY? YES! because..

1. **Rig time is saved when the oil, salt water or oil out mud are reversed out.**
2. **Dry drill pipe is pulled in much shorter time (no oil, or oil cut mud on the rig floor either).**
3. **Expensive drilling mud is saved from pollution of oil, salt or sulphur water.**
4. **Drill stem test can be made during the hours of darkness.**

Do a little figuring and you'll see how much more economy you can introduce in your operation by using the Johnston Circulating Valve for reverse circulation on drill stem tests.

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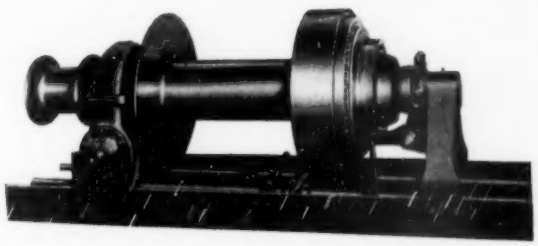
Tulsa friction clutch winches are favorites of contractors, riggers, steel erectors, pipe line contractors and public utility companies. The three-disc friction clutch and automatic worm brake assembly make these winches ideal for logging, ginning pipe, setting poles, pile driving, and raising or lowering any load requiring smooth acceleration and deceleration.

Whatever your winching requirements, there's a Tulsa Winch to do the job. Tulsa Winches are available in 28 different models, in capacities from 6,000 to 80,000 pounds and designed for use on all makes and sizes of trucks and crawler tractors.

For detailed information and prices, contact your nearest Tulsa Winch distributor or write direct to—



Tulsa* Winch

TULSA, OKLAHOMA — DIVISION OF VICKERS Inc.

*Reg. U.S. Pat. Off.

815-21 E. First Street

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1 ORDER THE BASIC AO R2000 RESPIRATOR FACE PIECE.

2 ARE DUST HAZARDS PRESENT?
Then order the protection needed from among the types on the right:

3 ARE CHEMICAL FUMES PRESENT?
Then order the cartridges needed from among the following below:

R32 for acid gases, fumes, mists from plating, pickling tanks, etc. such as sulphuric acid, hydrogen chloride, nitric acid.

R34 for protection against nuisance concentrations of ammonia.

R33 for combined acid and organic gases such as halogenated hydrocarbons, carbon tetrachloride, and acetic acid in degreasing operations, etc.

R31 for light organic fumes, vapors, and gases generated in paint spraying, degreasing, dry cleaning, cementing, etc.

R25 chemically treated felt filter for poisonous and disease-producing dusts and a combination of all dusts—toxic, nuisance and pneumoconiosis-producing. B.M. 2154

R15 cartridge for nuisance and pneumoconiosis-producing dusts in mining, quarrying and tunneling of quartz, sand, asbestos, coal and marble. B.M. 2121

R16 cartridge for toxic dusts caused by grinding and crushing lead, cadmium, arsenic, chromium, manganese, selenium, vanadium, etc. B.M. 2138

R17 cartridge for combination of all dusts—toxic, pneumoconiosis-producing and nuisance. B.M. 2138

AO R2000 RESPIRATOR

QUICK, SIMPLE INTERCHANGING—A twist of wrist removes outer cover, a second twist removes inner ring making replacement easy. Your nearest AO Safety Products Representative can supply you. AO also manufactures safety glasses and protective clothing for industry

American Optical
SAFETY PRODUCTS DIVISION

SOUTHBRIDGE, MASSACHUSETTS • BRANCHES IN PRINCIPAL CITIES

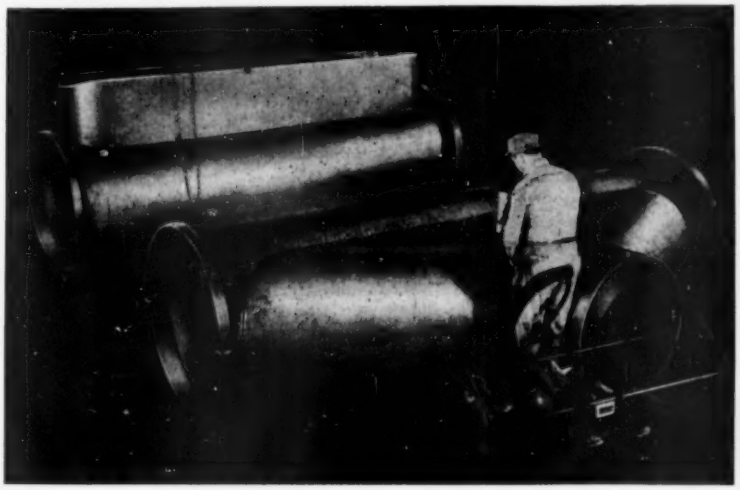
PROCESS EQUIPMENT NEWS

PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY SEPTEMBER, 1953

Exchangers Headed for Sumatran, African and Domestic Plants

Undergoing hydrostatic tests and inspection prior to shipment is this group of exchangers (see below) headed for several domestic refinery sites. Others, now being fabricated, will soon be shipped to a refinery in Palembang, Sumatra, and to South Africa.

The exchangers scheduled for South Africa are most unusual in that they will handle products at temperatures up to 1775°F. Specially-developed for this particular operation, the five units are being fabricated in the U.S. by Kellogg because of the firm's extensive experience in the welding of high alloy equipment.



Tubes and tube-sheets of the exchanger are being fabricated of Type 310 stainless steel. The shells are insulated on both the inside and outside. When in service the units will be employed for pre-heating feed gas going to a reformer that produces reaction gas for the synthesis of gasoline.

For further information, details of methods, etc. contact

FABRICATED PRODUCTS DIVISION
THE
M. W. KELLOGG
COMPANY
225 Broadway, New York 7, N. Y.
or offices in Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London & Paris

KELLOGG PULLMAN

Minimum Pressure-drop in Unusual High-Vacuum Condensers

These are the shells for two of four special vacuum condensers scheduled for installation this summer in a major Gulf Coast refinery. When in service they will condense the overhead from a vacuum tower which is part of a three-stage pipe-still now under construction.

They are designed to operate on the shell side at 53.5 mm of mercury. To obtain a minimum pressure drop of 1.65 mm, an unconventional design is used which permits a cross flow on the shell side.

Products Enter Through 36" Nozzle

A mixture of hydrocarbons, steam and inert gases enters the first condenser through the 36-inch diameter nozzle shown in the photograph to the right of the welder. Temperature is reduced from 175°F to 93°F as it passes through the two condensers which are connected in series. In the process all of the hydrocarbon material and most of the steam is converted to a liquid state.

When completed, the 44-inch shells will contain 16-foot admiralty tubes on a $1\frac{1}{4}$" square pitch. Tube sheets will be of naval brass as will the tube supports. Remainder of these two-stage condensing units will be made of carbon steel.

INCREASED EXCHANGER CAPACITY...

SHOWN HERE is the shell fabrication section of Kellogg's heat exchanger facilities which has been streamlined for production-line manufacture of tubular heat transfer equipment. Other sections of the plant have also been rearranged and new fabricating equipment has been added to accelerate the production of the wide variety of units regularly coming into the shop.

VICKERS

Long Stroke

HYDRAULIC PUMPING UNITS

Vickers Model JV-20400-A
20 ft stroke length
7 strokes per minute
35,000 lb polished rod
load capacity
Also available in 30-foot stroke

The Most for Your Money...

per foot of polished rod
travel based on
dynamic load capacity

Ask Us to Prove It!

WRITE FOR NEW BULLETIN 52-51

VICKERS Incorporated
Petroleum Equipment Department
2160 EAST IMPERIAL HIGHWAY • EL SEGUNDO, CALIF.

6043

BEST in the Long Run!

AMERICAN BOSCH MAGNETOS

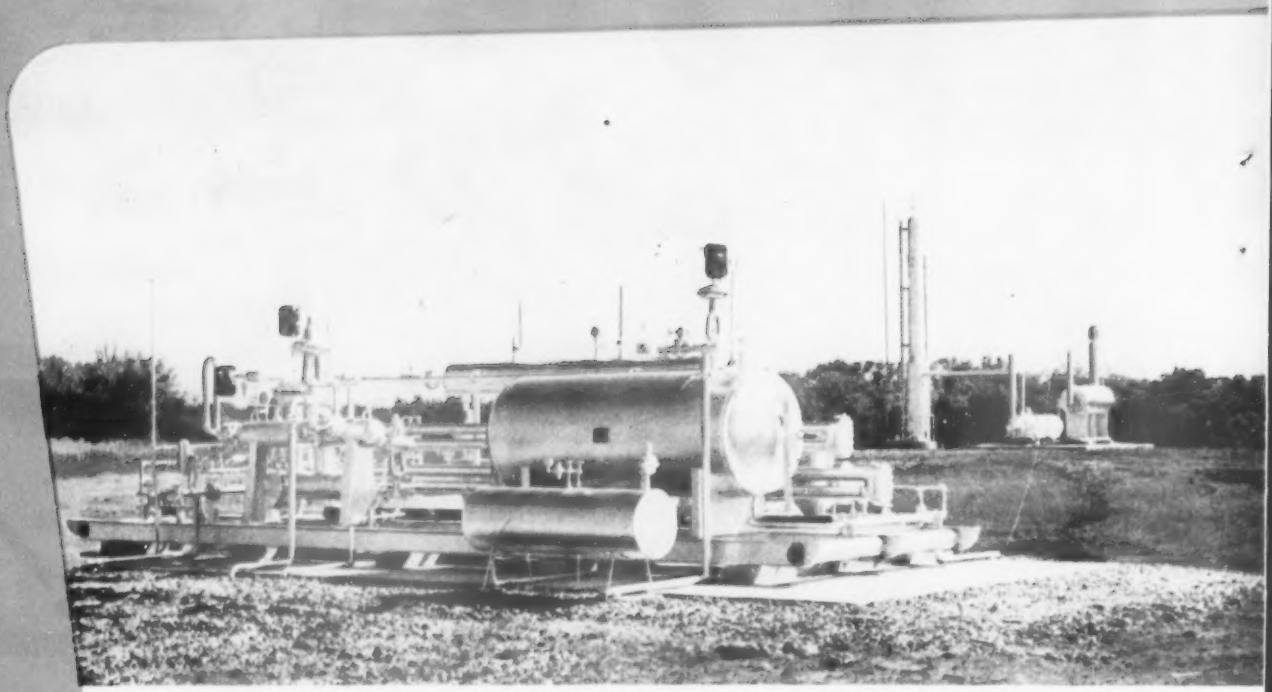
Time is money where oil industry equipment is concerned. American Bosch Super Powered Magnetos save on-the-job time for you. From starting time measured in seconds to trouble-free ignition measured in years, these rugged, power-packed Magnetos provide the constant, faultless spark that means maximum efficiency at all operating speeds and loads.

American Bosch Magnetos are precisely engineered for long, economical life on many types of producing, pipeline and refinery equipment—from the biggest, heavy duty engine right down to the most modern, high-speed power unit. That's why they are preferred as original equipment by many leading engine manufacturers.

With American Bosch you save to start with because of a liberal Trade-In Allowance on the old magneto you replace . . . you save in the long run because of dependable performance. Write today for all the facts and the name of your nearest Sales and Service Agency. American Bosch Corporation, Springfield 7, Massachusetts.

AMERICAN BOSCH

BS&B Glycol Injection System of Gives Us 20 to 50% More



These profit-minded operators have found that BS&B's Glycol Injection System of Low Temperature Separation with Stabilizer recovers and *keeps* more valuable condensate for them than any other available system. Whether your wells have an available pressure drop of as low as 400, or more than 1,000 psi., you too can realize greater profits from your operation with a BS&B System!

BLACK, SIVALLS & BRYSON, INC.

1708 West Main St. Oil & Gas Equipment Division—Dept. 1-A9 Oklahoma City, Oklahoma

Low Temperature Separation with Stabilizer*

Condensate Recovery . . . Say Operators!

*Patented and Patents Pending

News travels fast in the oil country!

More and more operators have been switching over to BS&B's Glycol Injection System of Low Temperature Separation with Stabilizer, because they have found that BS&B units recover 20 to 50% more condensate than is possible with conventional two-stage separation . . . a higher recovery rate than that afforded by any other low temperature separation system.

BS&B's Glycol Injection System operates at considerably lower temperatures than other comparable units. This system cools the well-stream below its hydrate formation temperature *before* expansion, and will produce a 30° dew point depression below separator temperature. Sales gas needs no further dehydration before delivery to the pipeline.

Your BS&B Man will gladly give you more details on these and other advantages of the BS&B Glycol Injection System . . . or we'll send you complete information on request.

BS&B's Glycol Injection System of Low Temperature Separation with Stabilizer greatly extends the profitable life of old wells, and makes new wells more profitable to operate throughout their life. Let your BS&B Man tell you about it!

EFFICIENCY
BS&B
RELIABILITY
OVER 60 YEARS

You dig 'em better with the right combination of

Power and Speed

This Operator has at his command over 30 *combinations* of digging wheel and crawler speeds, closely spaced and evenly graduated from 0.4 to over 29 feet per minute. This practical, exclusive Cleveland feature enables him to select exactly the *right* speed and power combination for *every* condition encountered on this tough 8″ pipeline job in Alberta—or on *any* trenching job.

This Trencher like all Clevelands, is *built tough* through finer design and tougher materials —*balanced better* through proper weight distribution on wide full crawler mounting. Clevelands dig more trench—longer—with less trouble and at less cost. It's in the records.

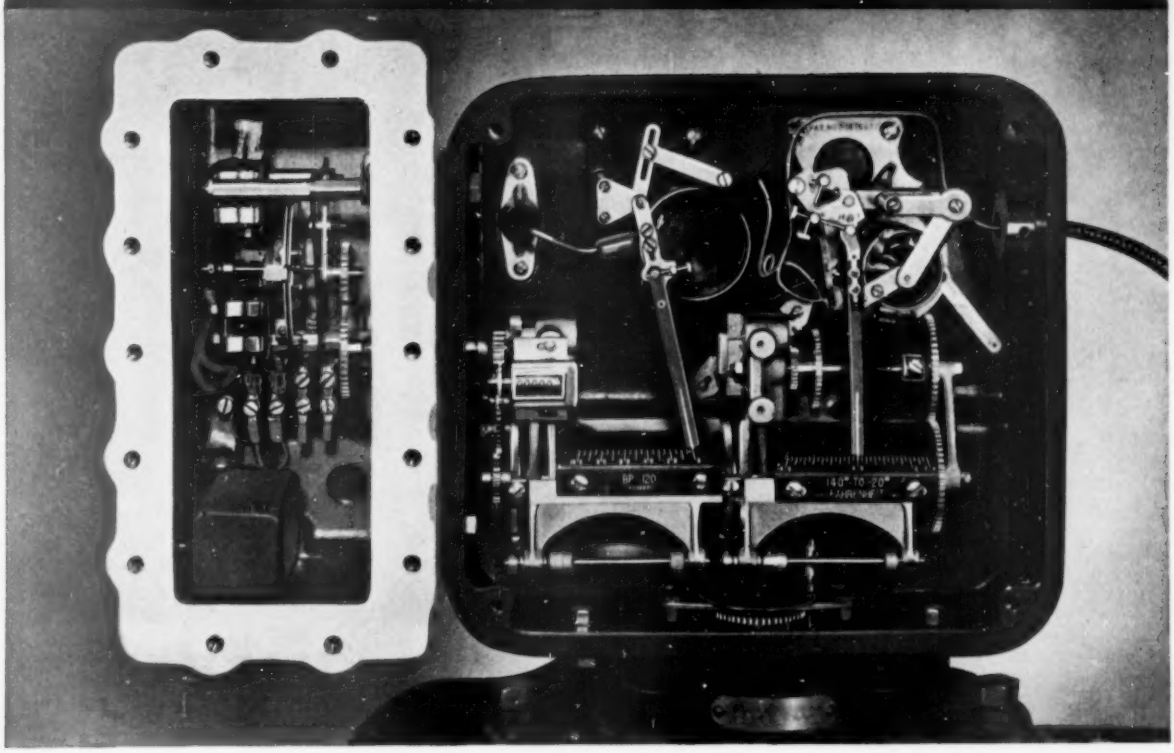
Ask your local distributor for the full story on Clevelands for pipeline trenching.

Pioneer of the Modern Trencher

THE CLEVELAND TRENCHER CO. 20100 ST. CLAIR AVE. CLEVELAND 17, OHIO

NEW AMERICAN® TELECOUNTERS

for base volume indexes



Now you can read base volume indexes at any remote location

American Télecounters accurately transmit Base Volume Index indications of gas quantities, computed to base temperature and base pressure conditions, to any convenient reading station. Remote indications are read from a compact reset-type counter which installs anywhere. The counter is actuated by electrical impulses received from the transmitter housed in the explosion-proof case on the side of the Base Volume Index.

- **Reset-Type Counter only 1¾"x 4"**
- **Explosion-Proof Transmitter Case**
- **Adapts to Large Capacity Ironcase Meters**
- **Reliable Transmission At All Times — Leased Wire, Private Wire Or Radio**
- **Power Pack Operates from Commercial 110 Volt, 60 Cycle, Single Phase Power Supply**

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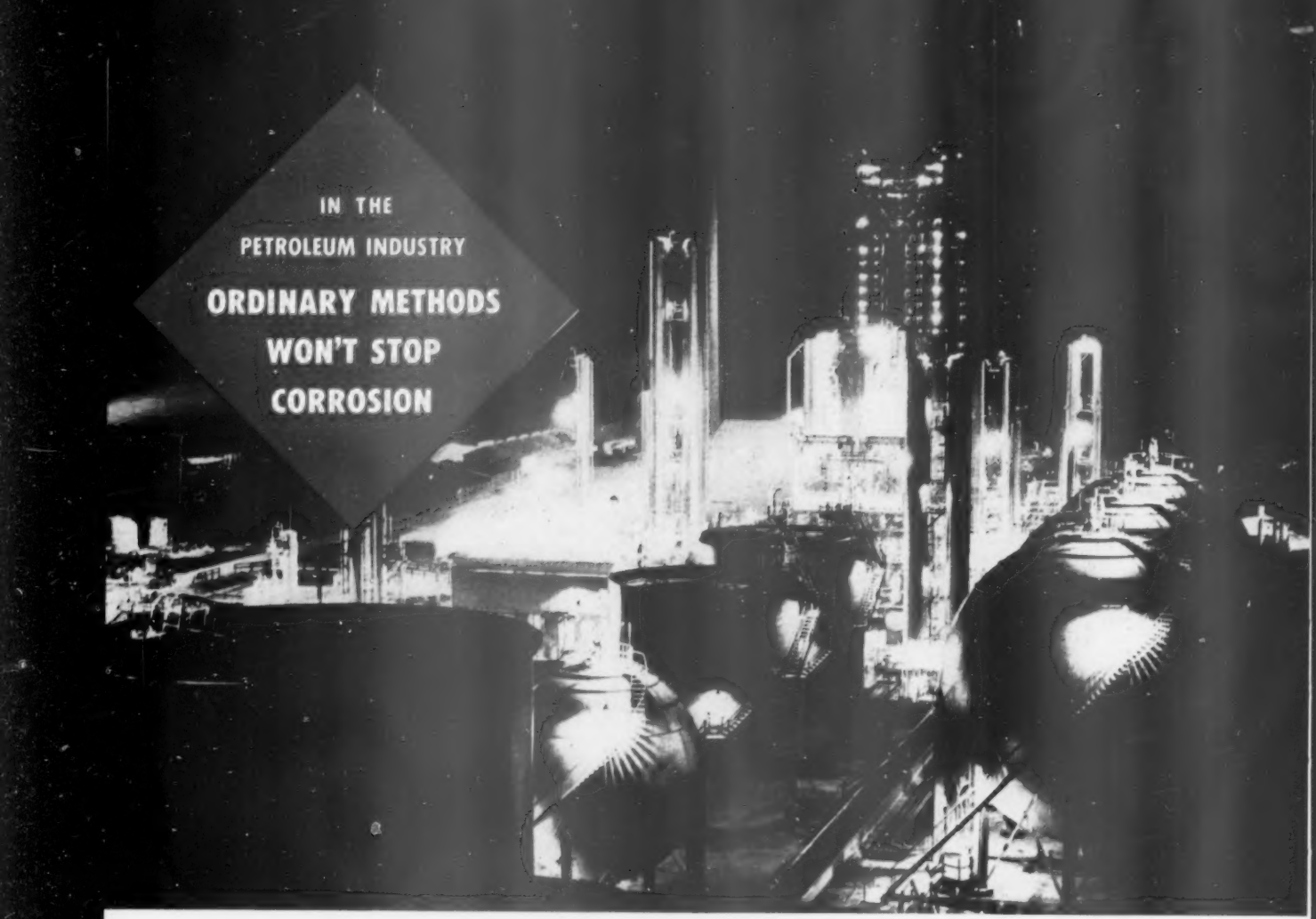
AMERICAN® METER COMPANY



SPECIFY THE AMERCOAT METHOD— Designed to Give You *PLUS* PROTECTION

Ordinary methods for controlling corrosion usually produce the ordinary results—rapid paint failure, costly replacements, product contamination, excess down-time, and hampered production. Halfway measures and the use of one or two general purpose coatings simply cannot provide adequate protection against corrosion's ceaseless attack.

Amercoat gives you a proven method of corrosion control, assuring you proper protection through these PLUS features:

1. Careful analysis by a trained engineer of all the conditions present in each corrosion problem.

2. The ONE best recommendation for the particular problem. AMERCOAT is a complete line of coatings, each formulated to solve or control specific corrosion problems.

3. On-the-job assistance to your applicators and supervisors by a trained engineer. The AMERCOAT method ensures proper attention to surface preparation and application techniques for maximum protection.

4. Complete stocks of fresh materials always near you at one of AMERCOAT's five regional warehouses or more than 20 franchised distributor warehouses throughout the United States.

5. Service based on experience. The AMERCOAT method of corrosion control is the result of nearly 20 years' experience in solving or controlling corrosion problems in every major industry throughout the United States.

Write today for the name and address of the AMERCOAT representative in your area. At no obligation, he will gladly help you analyze your corrosion problems and evaluate your present control measures. If it is determined that you have a problem within our scope of experience, he will outline a complete program of AMERCOAT's PLUS protection for your plant or equipment.

Amercoat
CORPORATION

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South Gate, Calif.
Chicago, Ill.
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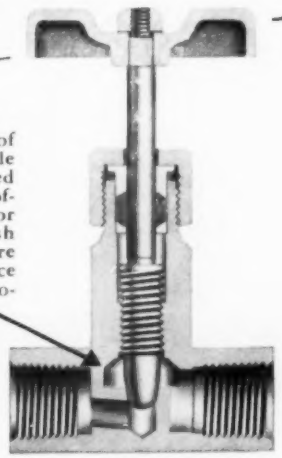
MAXIMUM WORKING PRESSURE
10,000 PSI
for water, oil or gas

- Body and stem guide extra heavy bar stock fused into one piece.
- Valve stem 416 stainless steel.
- Packing special one-piece "Marpak" moulded ring.
- Bodies marked in accordance with MSS regulations.

ONE PIECE

The stem guides of conventional needle valves are screwed into bodies—this often causes leakage or blow-outs. Marsh Needle Valves are fused into one-piece by exclusive "Conoweld" process.



Introducing-

The Ultimate in Needle Valves

Here is one of the crowning achievements of Marsh research, design, and manufacturing skill. It is the first needle throttling and shutoff valve to combine *all* of the qualities called for today in this highly critical and ever broadening field.

It is a valve that has strength and safety to spare . . . rated for pressures up to 10,000 psi—equally efficient in the lower ranges. A product of Marsh instrument-making and valve manufacturing experience, it combines instrument-like precision with the ruggedness that distinguishes all Marsh valve specialties.

The illustrations tell the story of new thinking; new standards. Body and stem-guide are machined from extra-heavy carbon steel bar stock. Still greater strength and rigidity are achieved by fusing the stem-guide into the body. The complete fusion of guide and body is accomplished by the exclusive Marsh "Conoweld" process.

There are two big advantages to this one-piece construction: (1) It eliminates the danger of unscrewing the valve from the body when opening—a frequent cause of leakage, even dangerous blow-outs (2) It permits perfect line-up of threads and seat. As a result, Marsh valves are easier to operate even at high pressures.

The precision-machined stem is 416 stainless steel. Stem threads are fine pitch for extra strength and fine, controlled regulation. Notable advancements are special "Marpak" one-piece, non-binding longer-lasting packing; deep thread chambers, keeping inlet and outlet piping away from ports and contributing excellent flow characteristics. Entire packing nut and packing gland are electro-zinc plated, preventing corrosion and giving the valve a handsome, plated exterior. The rugged malleable handle is finished in heavy baked enamel.

The new needle valve line includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾" and 1". Also globe and angle valves with male-inlet and female outlet in sizes ¼" and ½". *Complete stock carried at our Skokie, Illinois factory and also at our branch plant in Houston, Texas.*

Write today for catalog giving complete details.

MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*
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Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas

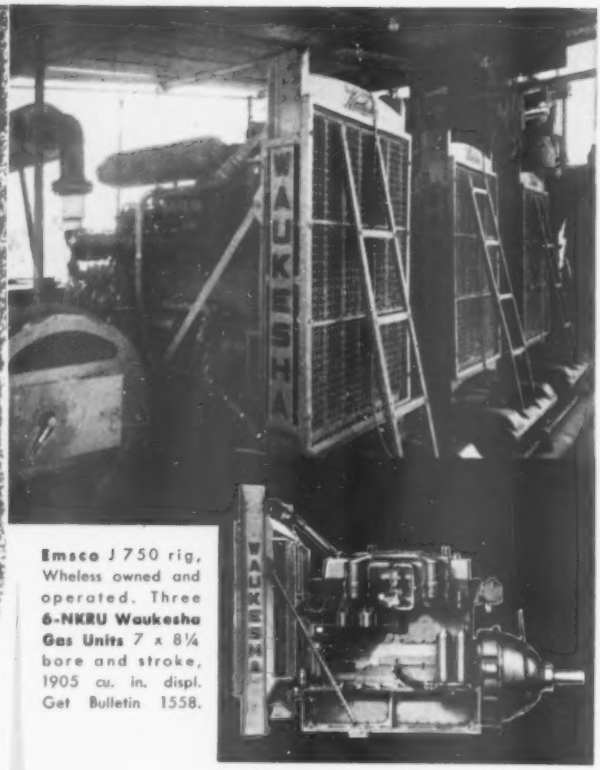
MARSH

"THE STANDARD OF ACCURACY"

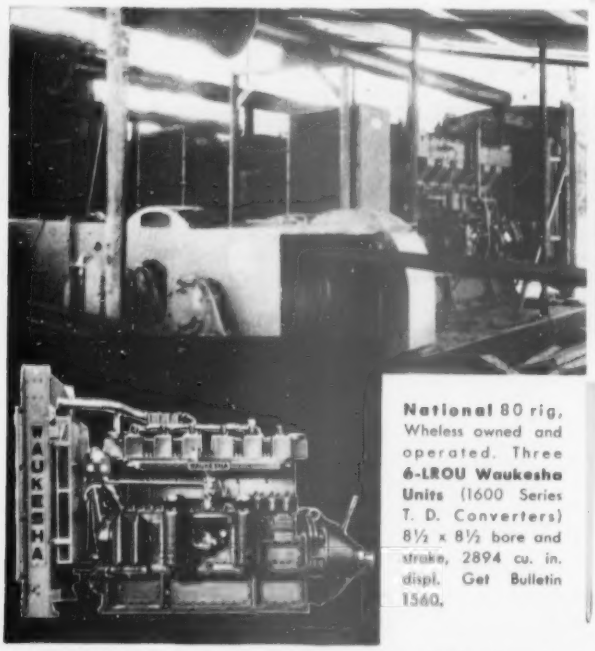
"Less down time with WAUKESHA than with any other engine I have ever used"

Nick Wheless, Jr., Vice President
WHELESS DRILLING COMPANY*
Shreveport, Louisiana

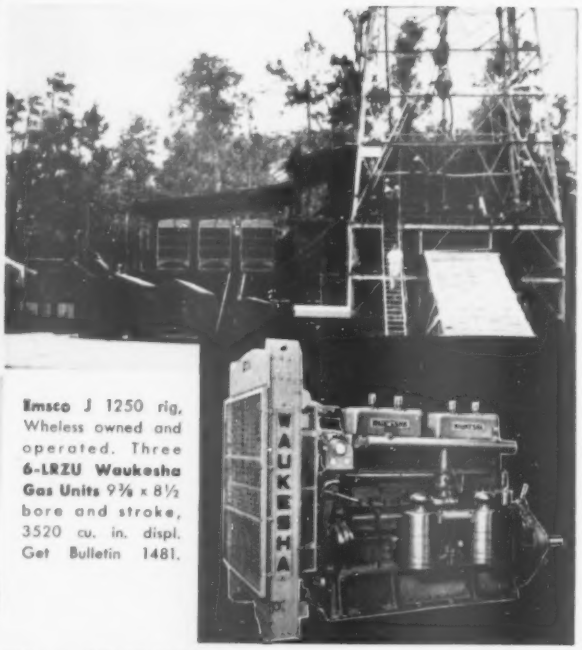
*Operators of 7 Waukesha-powered drilling rigs



Emsco J 750 rig, Wheless owned and operated. Three **6-NKRU Waukesha Gas Units** 7 x 8¼ bore and stroke, 1905 cu. in. displ. Get Bulletin 1558.



National 80 rig, Wheless owned and operated. Three **6-LROU Waukesha Units** (1600 Series T. D. Converters) 8½ x 8½ bore and stroke, 2894 cu. in. displ. Get Bulletin 1560.



Emsco J 1250 rig, Wheless owned and operated. Three **6-LRZU Waukesha Gas Units** 9⅜ x 8½ bore and stroke, 3520 cu. in. displ. Get Bulletin 1481.

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS. • NEW YORK • TULSA • LOS ANGELES

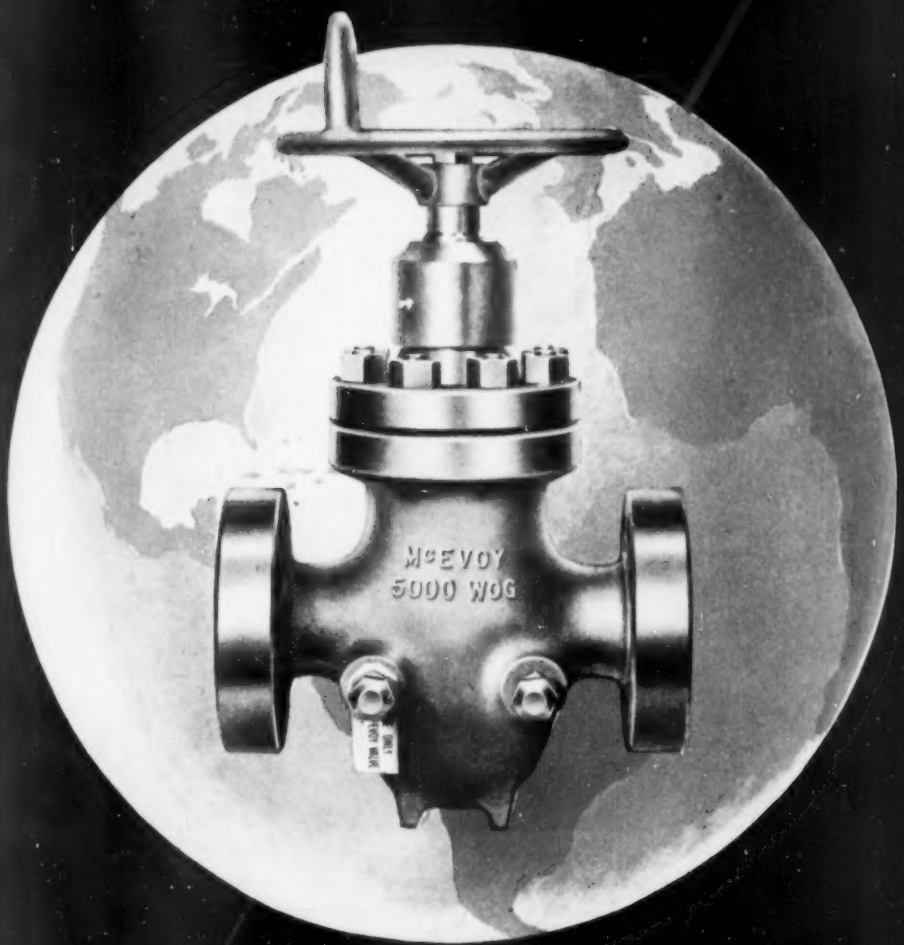
WAUKESHA

Diesel OIL FIELD POWER *Gas*

219

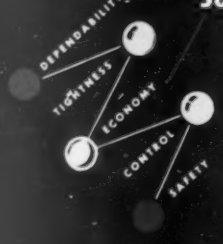
THE WORLD'S TIGHTEST

VALVES — THE McEvoy
(API AND ASA)



AUTOMATIC SELF SEALING CONDUIT GATE VALVES

Sold Through Leading Supply Stores Everywhere



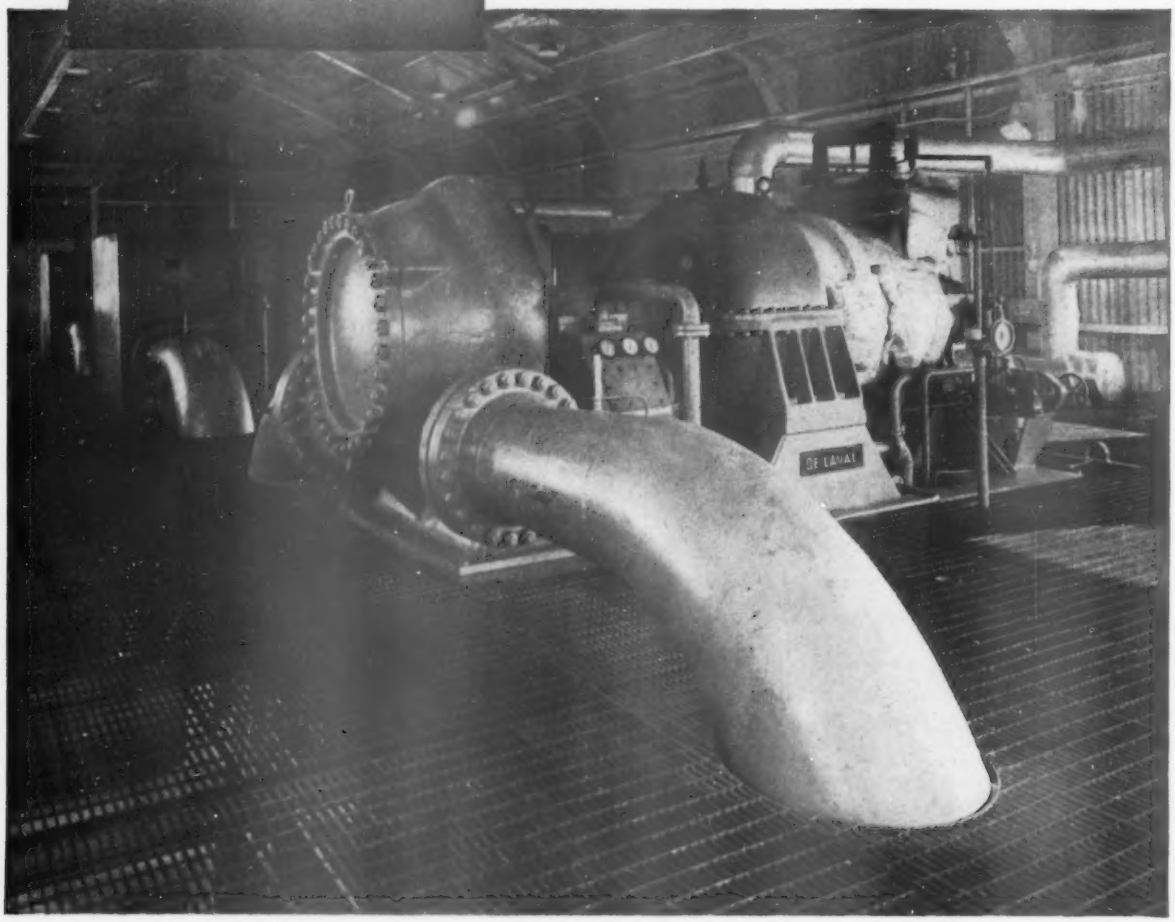
McEvoy COMPANY

TEXAS AND MILBY ST. P.O. BOX 3127

HOUSTON 1, TEXAS

DE LAVAL
CENTRIFUGAL COMPRESSORS

on the job at Transco



Today's modern, long-distance, high pressure gas transmission lines can't afford weak links. That's why the Transcontinental Gas Pipe Line Corporation selected these three efficient De Laval 5,000 hp steam turbine-driven centrifugal compressors for their Tylertown, Mississippi station.

There are sound reasons for their selection. The De Laval high pressure shaft seal eliminates leakage. Consumption of sealing oil is negligible. There is only one moving part—the rotor, which has ample clearances. These units are also compact, require smaller foundations and smaller stations. What's more, first cost and installation costs are low.

If a careful study of your needs indicates that centrifugal compressors are practical from an economic standpoint, it will pay you to consult our engineers. They can give you the benefit of our practical experience on all four of this country's major pipelines.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY
819 Nottingham Way, Trenton 2, New Jersey

DL184

Fig. 375—200-pound Bronze Gate Valve with renewable, wear-resisting "Powellium" nickel-bronze disc.

The name "POWELL" on a valve assures absolute dependability

Naturally, in buying a valve, the first consideration is its ability to perform a specific service. But that is not all. For it must also be a valve that will continue to function dependably for a long time. Powell Valves have an established reputation for absolute dependability.

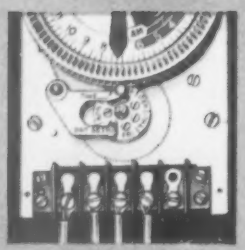
The Wm. Powell Co.
Cincinnati 22, Ohio

POWELL

DEPENDABLE VALVES SINCE 1846

BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES

Cutler-Hammer Program Time Switch gives automatically scheduled pumping, set up easily by means of pull tabs—one for each 15 minute interval.



Day-omission feature—for non-operation any selected days of week.

Cutler-Hammer 9589 Oil Well Pumping Controller with 3 coil overload protection and time delay relay.

ONE TRIAL WILL TELL YOU

It's Genuine

Oil Country Control

You'll only have to make a comparison *once* to see why Cutler-Hammer Oil Well Pumping Control is called *the* Oil Country Control and to see why oil men are installing it in preference to any others.

It is the outcome of a genuine, thorough and sincere contact with oil country conditions; with oil men's wishes. Not just to start, stop and protect motors and equipment successfully and dependably . . . but to meet and beat the oil country enemies of good performance . . . heat, humidity, static, dirt, dust, bugs, prevalent single phasing, sometimes careless handling.

Take a look at C-H. Note the ventilating openings that create a chimney draft to keep the "works" cool. Note the aluminum coating that bounces back the sun's rays. Note the out-in-the-open contacts that stay cooler and being "vertical," shed dust.

Note how all openings are screened, baffled, louvred to keep out dirt and dust, and bugs. See how Neoprene gasketing keeps dust out of the timer how the excess torque clock motor keeps "ticking" away even if dust gets in.

Take a look at the scheduling mechanisms, the easy on-off scheduling in 15 minute increments, the automatic day-omission feature. And there's manual or automatic restarting after an outage, either all at once or staggered starting.

Here's a popular feature too . . . optional 3 coil overload protection where single phasing is a problem; standard 2 coil where it is not a problem.

Note you don't have to rebuild or clean up the starter after a lightning arrester blows.

These are but some of the features that make this starter stand out like a derrick on a flat plain. Once you try it, you'll keep on using it.

CUTLER-HAMMER, Inc., 1453 St. Paul Ave., Milwaukee 1, Wis. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

Snyder, Texas

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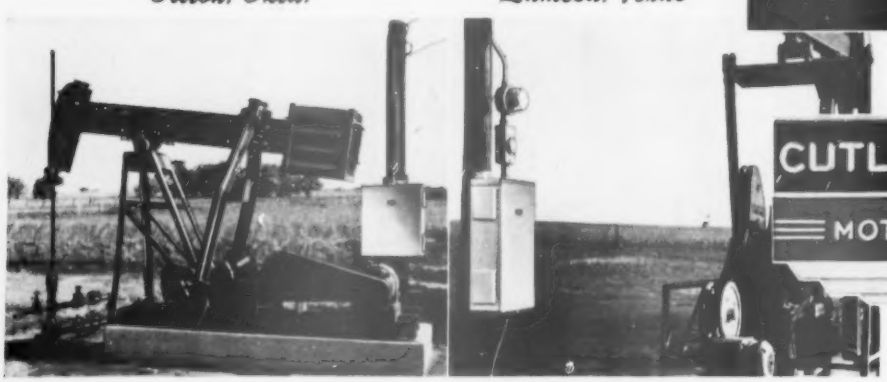
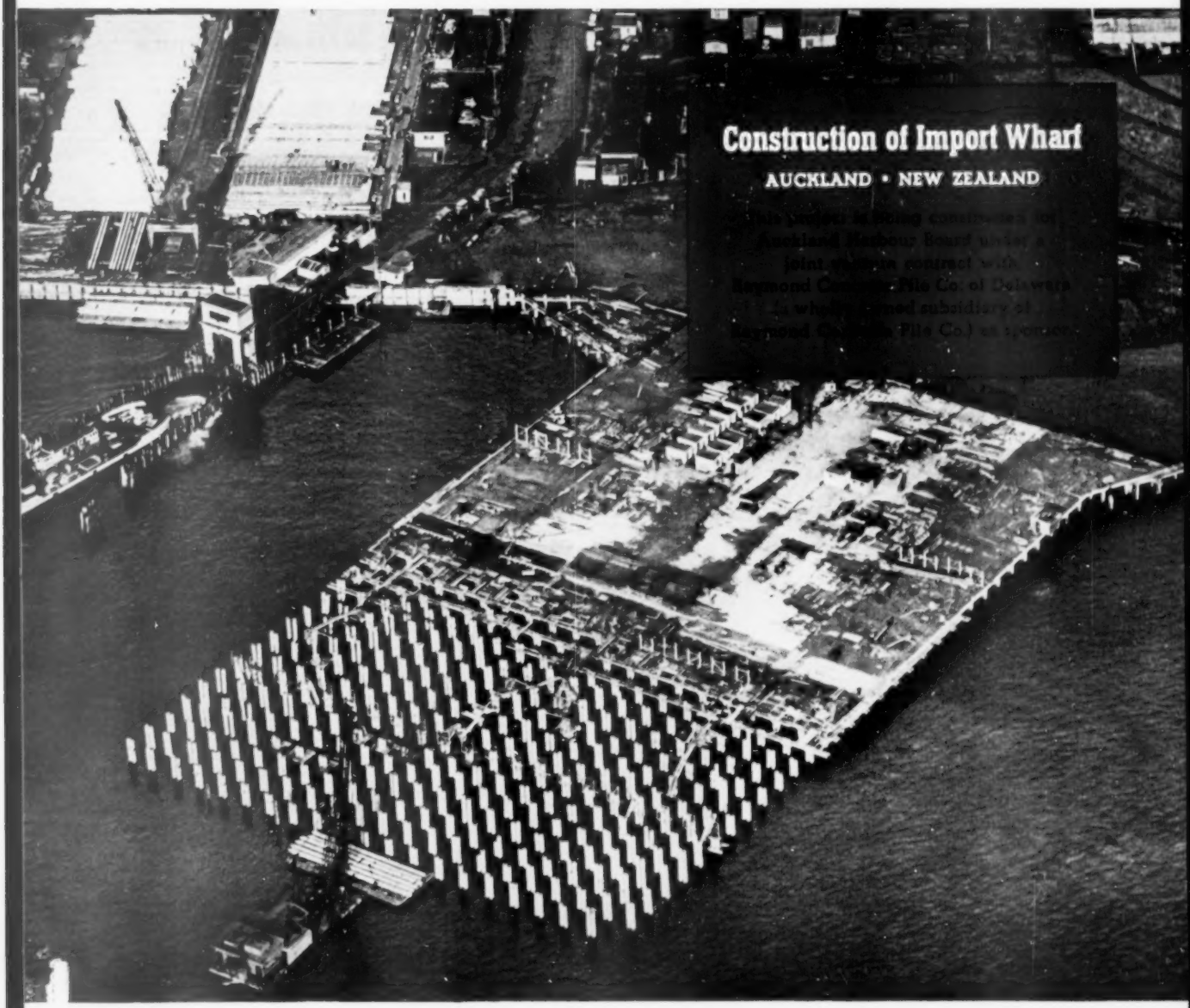
Lamesa, Texas



CUTLER-HAMMER
MOTOR CONTROL
C-H

MEMBER AMERICAN PETROLEUM INSTITUTE

DOWN UNDER with RAYMOND



A Raymond-supervised organization is constructing an ocean freight terminal in Auckland, which includes a large reinforced concrete pier of earthquake-resistant design, equipped with rail, warehouse and auxiliary facilities. When completed by mid-1953, the new facilities, providing berthing space for four big ocean freighters, will increase the capacity of the port by some 550,000 tons annually . . . another outstanding example of Raymond's service to the ports of the world.

RAYMOND CONCRETE PILE CO.

140 CEDAR STREET • NEW YORK 6, N.Y.

THE SCOPE OF RAYMOND'S ACTIVITIES . . . *FOUNDATION CONSTRUCTION* . . . *SOIL INVESTIGATIONS* . . . *IN-PLACE PIPE LINING* . . . *HARBOR AND WATERFRONT IMPROVEMENTS* . . . *SPECIALIZED CONSTRUCTION*

Again!

Gas Pulsation Prevented

by

BURGESS-MANNING SNUBBERS

THESE OUTSTANDING COMPANIES PLACED THEIR CONFIDENCE IN

BURGESS-MANNING

Oklahoma Natural Gas Company
Continental Oil Company
Midcontinent Petroleum Corp.
Skelly Oil Company
Standard Oil Company of Ohio
Public Service Company of Northern Illinois
Peoples Gas Light & Coke Co.
Aurora Gasoline Company
Pacific Gas & Electric Company
Union Oil Company of California

BURGESS-MANNING

☑ ENGINEERING
☑ DESIGN
☑ KNOW-HOW
for
☑ Best Performance in Operation

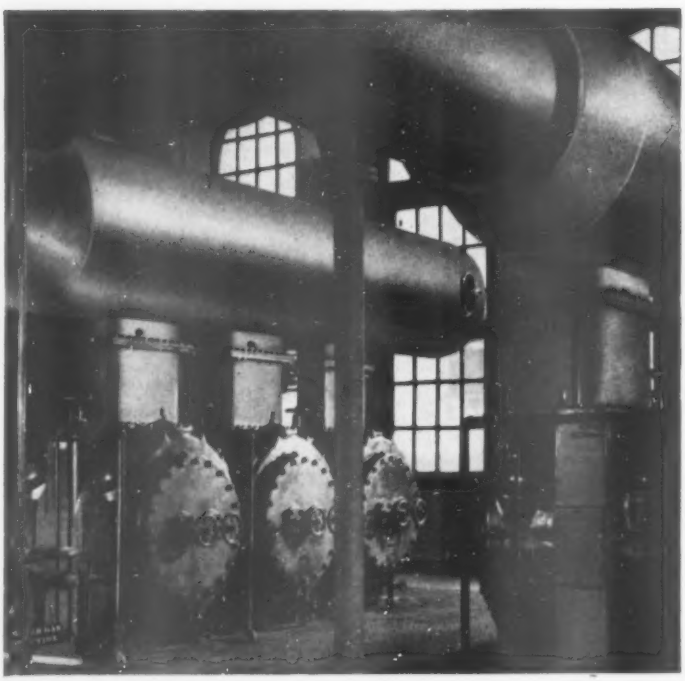
Individually engineered and designed Burgess-Manning Snubbers effectively control pulsation in gas and air piping excited by compressors, blowers, or reciprocating pumps. Pulsation control prevents line vibration and equipment fatigue with improved gas flow.

Smoother gas flow allows for best efficiency,
process action,
gas transmission,
and gas measurement.

We invite you to write for your copy of an actual field report in survey and analysis of surge control with Burgess-Manning Pulsation Snubbers.

THE PEOPLES GAS LIGHT AND COKE COMPANY

Burgess-Manning Pulsation Snubbers on Compressors



BURGESS-MANNING COMPANY

SOUND ENGINEERING

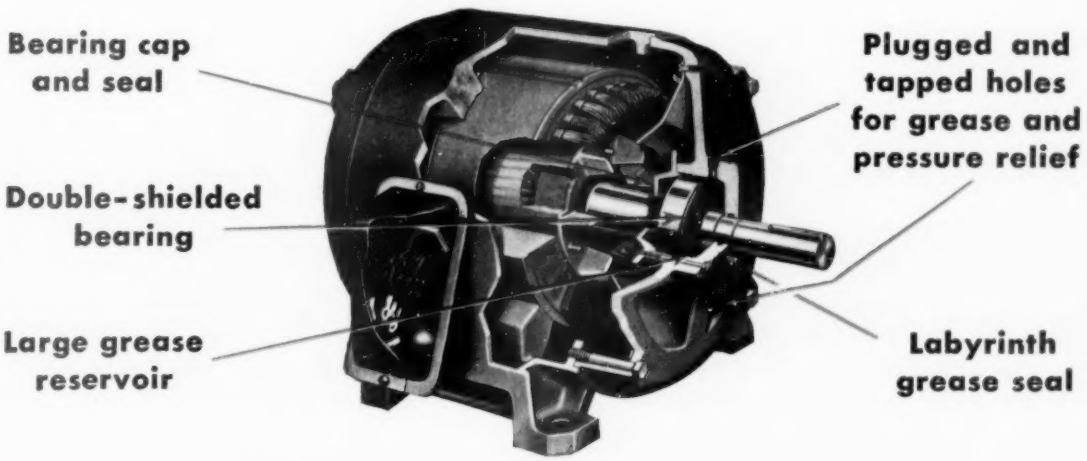
1203 DRAGON STREET
Dallas, Texas

CHICAGO, ILLINOIS • LIBERTYVILLE, ILLINOIS • REPRESENTATIVES: HOUSTON • TULSA • LOS ANGELES • ST. LOUIS • NEW YORK

Here Are Facts You Should Know About Electric Motor Bearings

An ideal motor bearing would operate for indefinitely long periods under all types of conditions without requiring any attention whatever. However, in the opinion of our engineers, such a bearing and its attendant lubricant are not yet available on the commercial market. Consequently, bearings for many types of operations, particularly where overloading, extreme temperature ranges and chemical and dirt laden atmospheres are involved, require special lubricants or regular lubrication schedules.

Of course, bearings suitable for many kinds of operation under normal conditions can be built to require no attention for very long periods — usually several years. Allis-Chalmers can supply sealed bearings in all frame sizes through 505 on short delivery and without extra cost for applications of this type.


Bearing cap and seal
Double-shielded bearing
Large grease reservoir
Plugged and tapped holes for grease and pressure relief
Labyrinth grease seal

Which is the Best Design for *Your* Application?

But, we believe that the design used in standard Allis-Chalmers drip-proof, tefc and explosion-proof motors represents the best design for most industrial users.

The Allis-Chalmers standard design consists of a prelubricated, double-shielded bearing mounted in the end housing with a generous grease reservoir. Plugged and tapped holes are provided for grease and for pressure relief. Under normal operating conditions, this design will operate as long without attention as any other type of bearing in use today. But where difficult operating conditions make relubrication desirable, it can be done as part of the normal lubricating-routine without dismantling the motor.

The large grease reservoir and shielded bearing design assure that grease lost from the bearing due to high operating temperatures or other causes will be replaced automatically.

For further information on bearing design and other features of Allis-Chalmers motors, call your nearby Allis-Chalmers District Office or Authorized Distributor. A-4130

ALLIS-CHALMERS

WHAT'S NEW AT BRISTOL...

Meet the WORLD'S SIMPLEST

It's Bristol's new METAGRAPHIC Pneumatic

for measuring, indicating, recording and controlling pressure, temperature, vacuum, flow, differential pressure, and liquid level

Here are a few of the advantages of Bristol's METAGRAPHIC system:

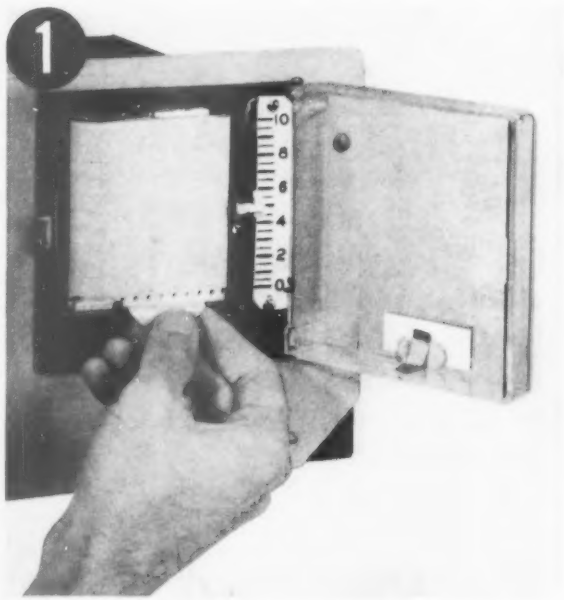
SIMPLICITY... fewer moving parts, fewer adjustments needed, and less service required. Range changes can be made in seconds.

FLEXIBILITY... all components are interchangeable. Units can be combined like building blocks to make up any kind of arrangement; functions can be located exactly where they're needed.

TRUE PLUG-IN SERVICE... provides great savings in installation costs. And if trouble is suspected with any component, just pull the doubtful unit out and plug in a stand-by—*without stopping any processing*. The suspected unit can be taken to the shop and checked whenever time permits. You don't lose any air pressure when changing units, either. Bristol's automatic sealing system prevents loss of signal to other components.

NO TIME LAGS... in a four-pipe circuit the transmitter signal and the controller-output signal travel around a very short loop—which can be as little as three feet long.

These are some of the important advantages of Bristol's METAGRAPHIC instrument system—the product of over 60 years of experience in instrument making and application in practically every industry. Get the whole story by writing to The Bristol Company, 120 Bristol Road, Waterbury 20, Conn.



IT TAKES ONLY SECONDS to change the Bristol METAGRAPHIC receiver from a recorder to an indicator: Case door is opened...

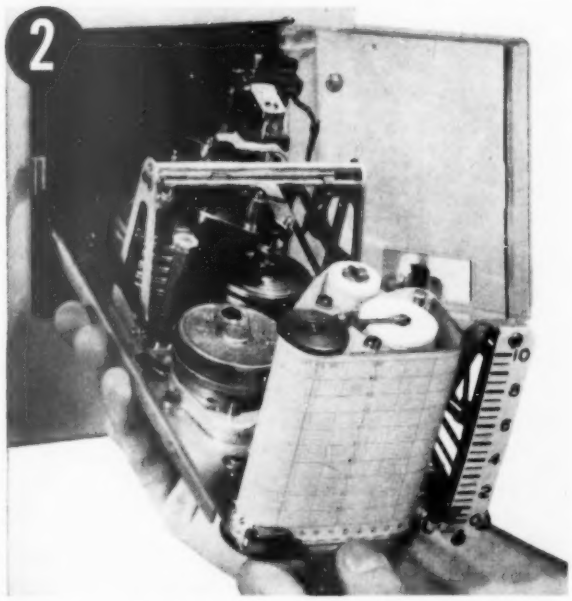
Here are the basic components—

BRISTOL PNEUMATIC TRANSMITTER, with cover removed to show simplicity of the world-famous Bristol measuring element. The frictionless transmitter, with only one pivot and no flexures, will operate in any position, indoors or out. The unit is sensitive to extremely small changes in the measured quantity, as minute as 0.03% of range, including reversal.

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

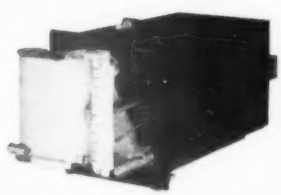
INSTRUMENT SYSTEM!

Transmission instrument system . . .



Recorder chassis withdrawn from case (air pressure is automatically maintained) . . .

Indicator chassis is plugged into same case. Control remains undisturbed throughout change-over.



HERE'S THE RECORDER CHASSIS, in retracted position. Now pen can be inked, set point and zero adjustment made without disturbing record or control. You can bring up to three related variables, such as flow, pressure and temperature, into one receiver. Auto-manual switching is foolproof and "bumpless," without disturbing valve position.

THE BRISTOL CONTROLLER can be plugged into back of receiver, placed at process, or used as a "blind controller." Available in on-off, proportional, proportional plus reset, proportional plus derivative, and proportional plus reset plus derivative. Experienced instrument men will recognize this as a unit service-proved by thousands of installations.*

*Licensed under C. B. Moore patents

LOOK FOR OUTSTANDING NEW DEVELOPMENTS FROM BRISTOL

BRISTOL

THE DEPENDABLE GUIDEPOST OF INDUSTRY

Take a closer look at the

MACHINABILITY

of B&W mechanical tubing

You'll like it

You'll find the machining characteristics of B&W Mechanical Tubing make it adaptable for turning out hollow cylindrical parts with any type of machine tool on mass production or jobbing basis. You can get this versatile tubing in grades, tempers, finishes and sizes to suit any combination of production conditions and product specifications. And no matter what analyses you need—carbon, alloy or stainless steels—to get the desired physical properties in your finished machined parts, B&W can supply them.

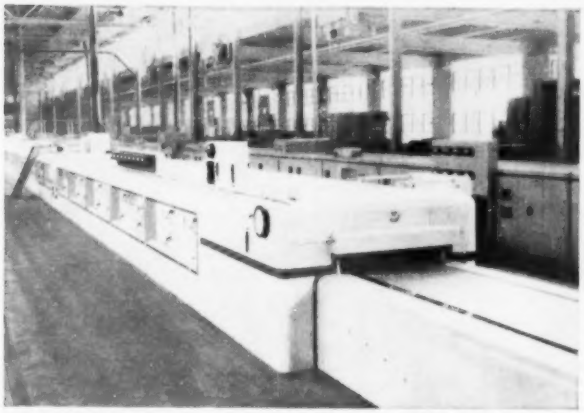
You'll find Mr. Tubes—your nearby B&W Tube Representative—a good man to consult when you need help in determining the best available mechanical tubing for your specific requirements.

B&W SEAMLESS and WELDED TUBES

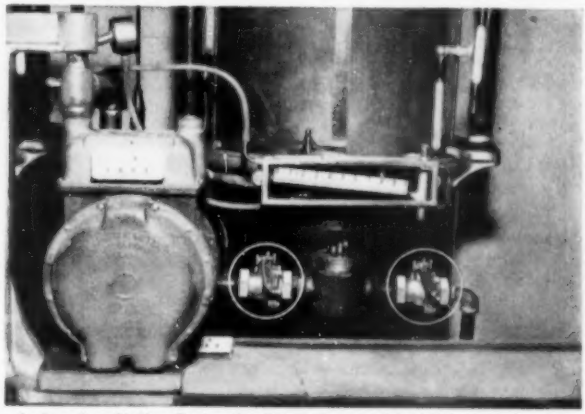
THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

TA-1751(M)

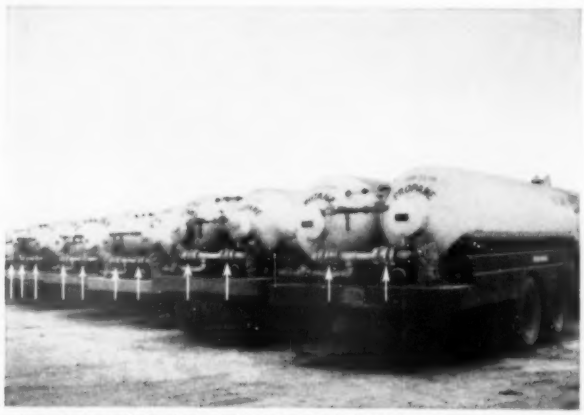
Do you need a LEAKPROOF VALVE?



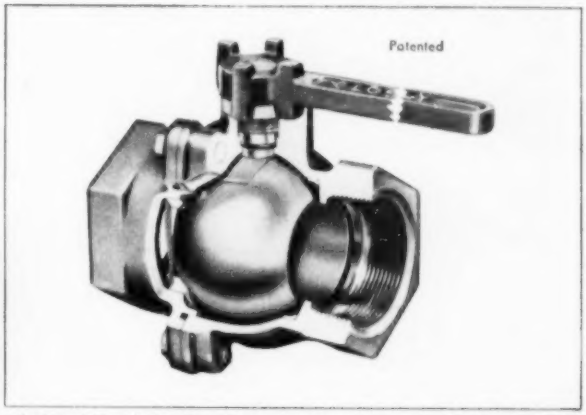
Leakproof in a Bakery where escaping gas and gas odor are a hazard. Rockwood Ball Valves, used in the ovens above, hold tight despite adjustment at various times to control flow of natural gas.



Leakproof on Air Lines Testing Gas Meters. Rockwood Ball Valves, used on air lines above, are opened and closed 1000 times a day, have completed two years' service without leakage, without maintenance.



Leakproof on LP Gas Trucks where flammable bottled gas must not escape. Rockwood Ball Valves, used on trucks above, prove not only leakproof but longer wearing at less cost. Fleet operator praises them.



Leakproof for a Longer Time. Rockwood Ball Valves are designed to operate under the roughest and most grueling of conditions. They pay for themselves over and over wherever they are in service.

Note these other exclusive features!

Full Round Flow — assuring fast, efficient operation, less friction loss.

Quick Opening and Closing — needs only ¼ turn even under full pressure.

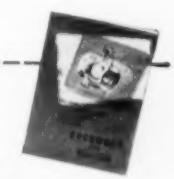
Resists Wear Longer — Chrome-plated bronze ball stands up under abrasion, pitting and scratching.

Rockwood Ball Valves are used in all types of applications throughout the petroleum field. Perform with trouble-free continuity. Longer time between replacements, less maintenance on the job. Comes in all pipe sizes. Tested and listed by Underwriters' Laboratories, Inc. The coupon will bring you complete information.

ROCKWOOD

THE FLOW IS AS ROUND AS THE PIPE ITSELF

***FULL-FLOW* BALL VALVES**



ROCKWOOD
SPRINKLER COMPANY
104 Harlow Street, Worcester 5, Mass.

Send me illustrated folder V-4 on Rockwood Full-Flow Ball Valves.

Name.....

Title.....

Company.....

City.....

Zone.....State.....

Handclasp of a friend-in-need

There's confidence in the very "feel" of the world famous C-O-TWO Squeez-Grip Carbon Dioxide Type Fire Extinguishers. The quick-acting "Squeez-Grip" fits your hand naturally like a handclasp ... hangs right ... carries right ... works right. You're in complete command of the situation instantly ... no fumbling ... no fatigue.

From the non-conducting, shatterproof discharge horn to the high strength, durably finished cylinder, you get top quality construction that results in a lifetime of satisfactory service. Because of the very few working parts and corrosion resistant materials throughout, the total cost to you over the years is less than other initially lower priced makes ... fire after fire, recharge after recharge, without trouble.

It's not hard to see, when you fully compare and try, why C-O-TWO Squeez-Grip Carbon Dioxide Type Fire Extinguishers are your best buy for killing flammable liquid and electrical fires, as well as some surface fires involving ordinary combustible materials. Sizes range all the way from 2½ to 100 pounds capacity ... all fully approved by the Underwriters' Laboratories, Inc., Factory Mutual Laboratories, Armed Forces and Government Bureaus.

With C-O-TWO Squeez-Grip Carbon Dioxide Type Fire Extinguishers the penetrating carbon dioxide is a clean, dry, non-damaging, non-conducting, inert gas ... smothers fire instantly, leaves no after fire mess ... harmless to equipment, materials and finishes ... even food is still perfectly edible.

Act now for complete free information on these first-rate, sure-acting fire extinguishers. Remember fire doesn't wait ... get the facts today!

C-O-TWO

MANUFACTURERS OF APPROVED FIRE PROTECTION EQUIPMENT

Squeez-Grip Carbon Dioxide Type Fire Extinguishers
Dry Chemical Type Fire Extinguishers
Built-In High Pressure and Low Pressure Carbon Dioxide Type Fire Extinguishing Systems
Built-In Smoke and Heat Fire Detecting Systems

C-O-TWO FIRE EQUIPMENT COMPANY
NEWARK 1 • NEW JERSEY

C-O-TWO FIRE EQUIPMENT OF CANADA, LTD. • TORONTO 8 • ONTARIO

Sales and Service in the Principal Cities of United States and Canada

AFFILIATED WITH PYRENE MANUFACTURING COMPANY

ONLY POLYKEN PROTECTIVE TAPE COATINGS PROVIDE

2-way corrosion control

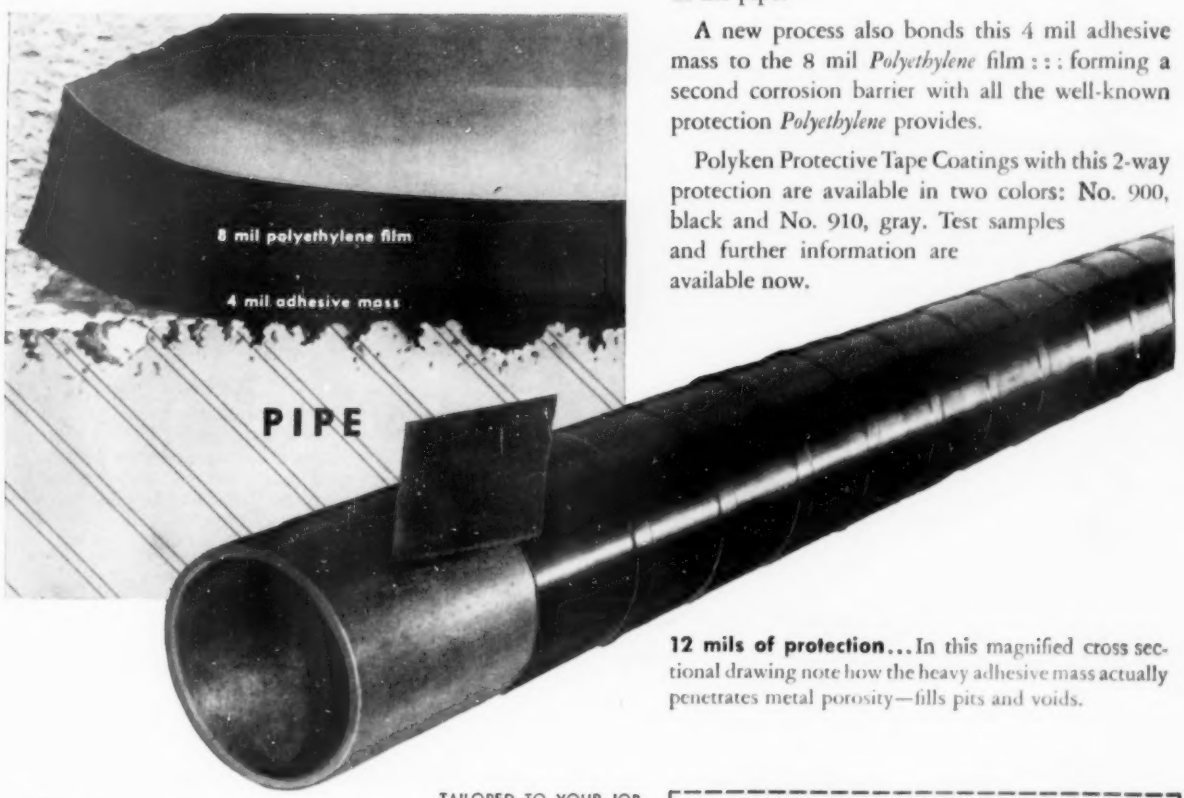
in a single wrap

This magnified drawing shows that Polyken Protective Tape Coatings are actually a bond of two anti-corrosion barriers—each one highly effective in itself:

Bonded to the pipe is a specially developed synthetic adhesive that provides excellent protection over a wide range of temperatures and conditions: As the drawing indicates, the adhesive mass is unusually thick so it fills surface voids, pits and pores of the pipe.

A new process also bonds this 4 mil adhesive mass to the 8 mil *Polyethylene* film : : : forming a second corrosion barrier with all the well-known protection *Polyethylene* provides.

Polyken Protective Tape Coatings with this 2-way protection are available in two colors: No. 900, black and No. 910, gray. Test samples and further information are available now.



12 mils of protection... In this magnified cross sectional drawing note how the heavy adhesive mass actually penetrates metal porosity—fills pits and voids.

TAILORED TO YOUR JOB

Polyken®

INDUSTRIAL TAPES

Department of Bauer & Black
Division of The Kendall Company

Polyken, Dept. OGI, 222 West Adams St.
Chicago 6, Illinois

Please send me samples and further information on POLYKEN PROTECTIVE COATINGS.

Name _____ **Title** _____

Company _____

Street Address _____

City _____ **Zone** **State** _____

NOW...fast, accurate transmission of DIFFERENTIAL PRESSURE MEASUREMENT with the Ashcroft Pneumatic Transmitter

Thousands of Ashcroft Pneumatic Transmitters are accurately measuring *straight pressures* in processing plants everywhere. Now, coupled with an exceptionally rugged differential pressure cell, the Ashcroft Transmitter assures the same standard calibrated accuracy of ½ of 1% in measuring *differential pressures.*

The Ashcroft Pneumatic Transmitter with Differential Pressure Cell is ideal for oil refineries, chemical plants or wherever it is good safety engineering to confine inflammable, poisonous or corrosive liquids or gases close to their source—away from control centers.

This new combination provides a durable and dependable system suitable for static pressures up to 4500 psi. It operates on low-pressure air—transmits proportionate air pressure to one or more pressure-actuated receiving indicators, recorders and controllers up to 1000 feet away. Response is fast—only 3 to 10 seconds for full scale change.

Installation is easy and economical. Low-cost, small-diameter piping is used. You avoid expensive high-pressure lines and fittings and all their leakage and maintenance problems.

Learn all about the basic types and differential pressure ranges in which the Ashcroft Pneumatic Transmitter with Differential Pressure Cell can be supplied. Write for Bulletin 330.

YOUR INSTRUMENT DISTRIBUTOR makes it his business to keep up with all that's new in process equipment. Call on him for practical counsel, efficient service and products you can depend on to save time, effort and money.

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

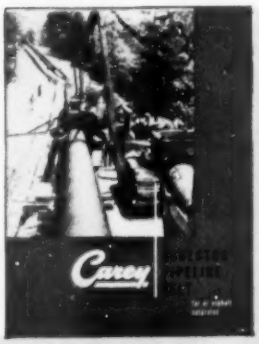
If YOUR JOB INVOLVES

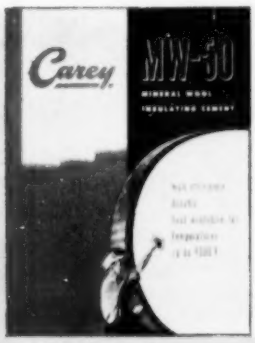
- oil or gas pipelines
- processing operations
- refinery construction or maintenance...

You need this helpful literature!

Asbestos pipeline felt data book...

a discussion of protective coatings for pipelines by a competent corrosion engineer. Covers the fundamentals of low cost, dependable pipeline protection. Timely, informative, fully illustrated.



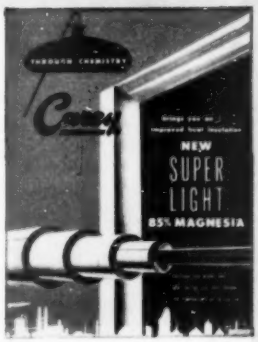


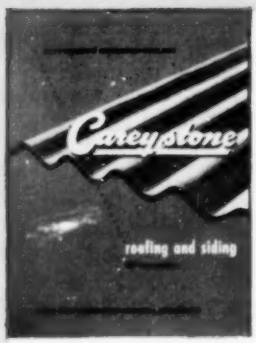
Carey MW-50 data book...

describes the most modern method for insulating all types of heated equipment having temperature ranges up to 1800°F., and gives details for applying insulation on irregular or hard-to-reach surfaces.

Super-Light 85% magnesia data book...

description, specifications and recommended uses for a new, improved insulation in precision-sized monolithic blocks, molded pipe coverings and cements.





Careystone corrugated asbestos-cement roofing and siding data book...

technical data, application details and specifications covering the economical use of Careystone asbestos-cement for all types of buildings.

Get the Carey Data Books you need absolutely free. Ask your Carey Industrial Sales Engineer, or just fill in coupon and mail today. No obligation!

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The Philip Carey Mfg. Co.
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Gentlemen: Please send me without charge the Carey Data Books on ☐ PipelineFelt ☐ Super-Light 85% Magnesia Insulation ☐ MW-50 Cement ☐ Careystone Asbestos-Cement Roofing and Siding. Place check mark in box before Data Books wanted.)

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Company _____
Address _____
Position _____
City _____ Zone ____ State ____

On the CRUDE OIL and PRODUCTS PIPE LINES across America.....

The trend is toward NORDBERG POWER!

ON the crude oil and products pipe lines across America, the trend is toward Nordberg *SUPAIRTHERMAL** engine power. The reasons are simple and sound . . . because *SUPAIRTHERMAL* engines produce *more* power in *less* space—substantially reducing installation and operating costs. What's more—the efficiency of these powerful engines is made possible through a patented inlet valve timing control which turns low fuel consumption rates into *profit dollars* at the end of the line.

Nordberg *SUPAIRTHERMAL* engines are available in a full range of four-cycle types from 535 to 4260 hp for Diesel, Duafuel® or spark-fired gas operation. The *SUPAIRTHERMAL* principle of operation increases the engine's load-carrying ability at any given speed, over a wide speed range. This reserve power is like "*money in the bank*" when additional line capacity is needed.

For further details, send for Bulletin 191.

*Trademark

NORDBERG MFG. CO., Milwaukee, Wisconsin

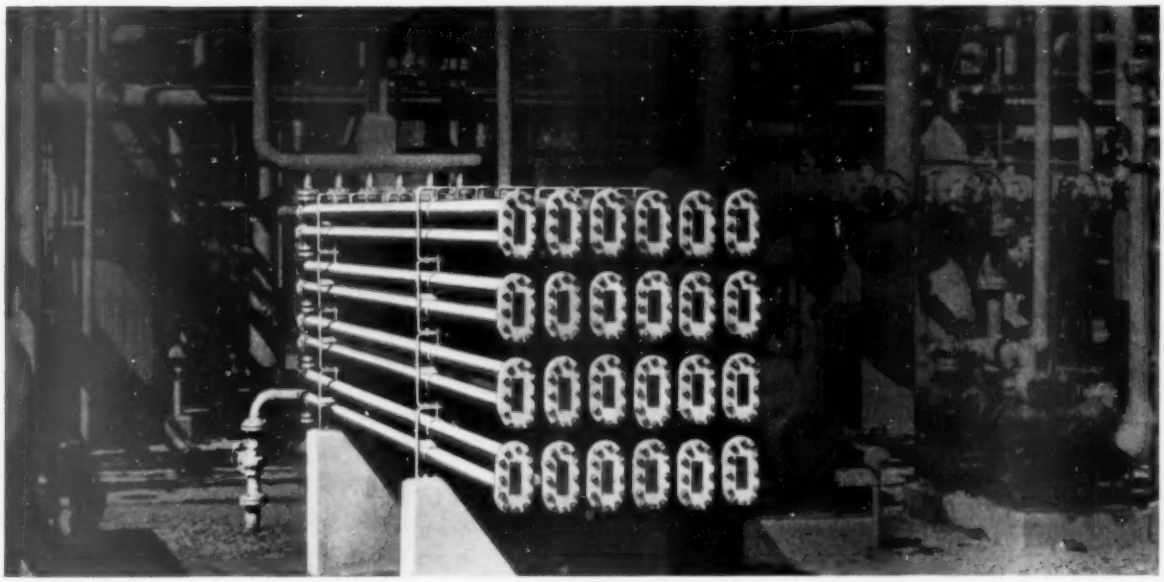
NORDBERG

DIESEL • DUAFUEL® AND SPARK-FIRED GAS ENGINES

O-153

Eliminate Down-Time

in your plant with



BROWN FINTUBE *Sectional* HEAT EXCHANGERS

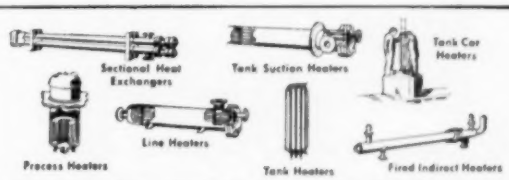
● Simply manifolding an extra parallel stream into a bank of Brown Fintube Heat Exchanger **Sections,** permits one group of sections after another to be taken off-line, and cleaned, while the rest of the unit — always thoroughly clean — carries the exchanger's full rated capacity, year after year, without shut-downs.

This avoids the necessity of carrying a 100% standby unit, to assure continuous operation, as when a "bundle" type heat exchanger is used. It permits the sections to be cleaned as frequently as the duty requires without affecting other parts of the plant. It avoids the loss in efficiency that results from just a few thousandths of an inch of deposit on the tubes; and assures clean surfaces and highly efficient operation at all times.

Eliminating down-time is only one of Brown Fintube's many advantages. Flexibility to meet changing plant requirements; reduced fouling; and prompt delivery are some of the others. Bulletin No. 512 contains full details; and will give you many proven, money-saving ideas! *Send for a copy.*

BROWN FINTUBE

BROWN FINTUBE CO.
Elyria, Ohio



NEW YORK • BOSTON • PHILADELPHIA • PITTSBURGH • BUFFALO • CLEVELAND • CINCINNATI • DETROIT • CHICAGO • ST. PAUL • ST. LOUIS • KANSAS CITY
MEMPHIS • BIRMINGHAM • NEW ORLEANS • SHREVEPORT • TULSA • HOUSTON • DALLAS • DENVER • LOS ANGELES • SAN FRANCISCO • and ST. THOMAS, ONT.

Graphic control . . . *for leading industries*

The well-established trend to centralized graphic instrumentation has brought with it many specific advantages to the operation of complex, modern processing units. And to realize most fully the potential advantages of improved efficiency, simpler supervision and better coordination, many leading companies have turned to Honeywell graphic control.

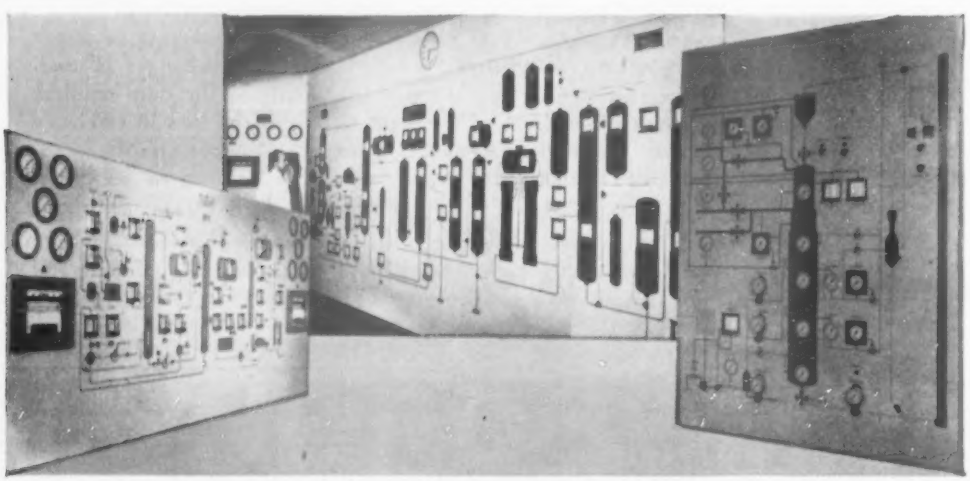
Among the engineering, construction and producing organizations which use Honeywell panels are some of the best-known names in their fields. The ever growing list includes:

C. F. Braun
Catalytic Construction Co.
The Fluor Corporation Ltd.
Foster Wheeler Corp.
Gulf Oil Corporation
Imperial Oil of Canada
M. W. Kellogg
The Lummus Co.
Pan-Am, Southern
Phillips Petroleum Co.
The Refinery Engineering Co.
Shell Oil Co.
Sinclair Refining Co.
Socony-Vacuum Oil Co.
Standard Oil Co. of California
Standard Oil Co. of Indiana
Standard Oil Co. of New Jersey
The Texas Company
Tide Water Associated Oil Company
Union Oil Co. of California

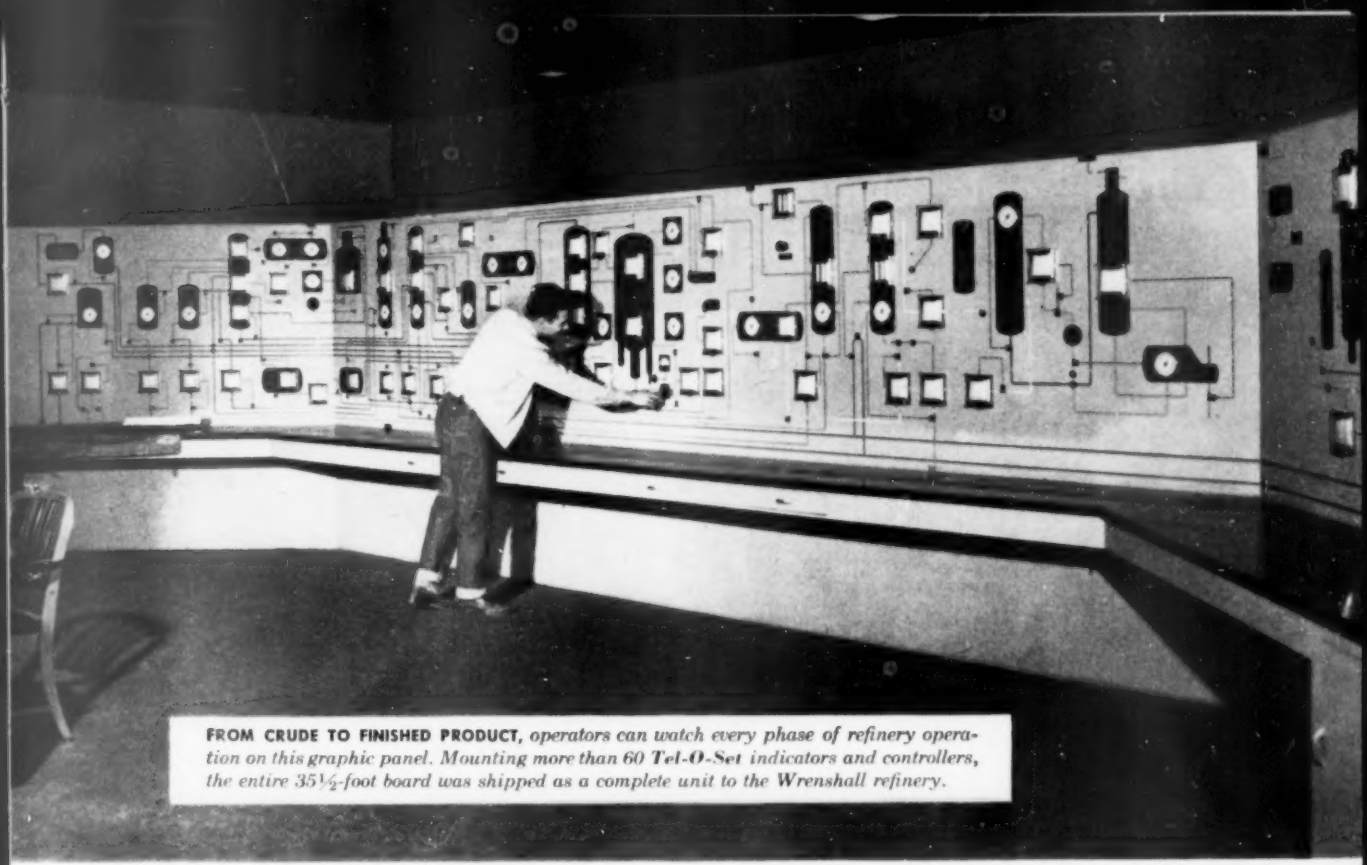
Reasons for acceptance

Behind this industry-wide acceptance stand several definite reasons. First is system engineering . . . by graphic panel specialists who translate process requirements into an integrated, harmonious design. Second is instrumentation . . . including a full line of *Tel-O-Set* miniature indicators, recorders and controllers, and *ElectroniK* instruments for supplementary recording, which enable Honeywell to satisfy the requirements of every phase of process control. And third is workmanship . . . skilled assembly either in a manufacturing department devoted exclusively to this work, or, if desired, at the job site by our own experienced branch installation crews—an organization built up over 15 years for the installation of industrial and commercial control systems.

Graphic control *centralized*



FUNCTIONAL DESIGN *for maximum efficiency is the keynote of Honeywell graphic instrumentation. These typical panels show a few of the varied types which have been built for varied process applications.*



FROM CRUDE TO FINISHED PRODUCT, *operators can watch every phase of refinery operation on this graphic panel. Mounting more than 60* ***Tel-O-Set*** *indicators and controllers, the entire 35½-foot board was shipped as a complete unit to the Wrenshall refinery.*

for complete refinery *on a single Honeywell panel*

THE MOST up-to-date concepts of petroleum processing were embodied in International Refineries' new plant at Wrenshall, Minnesota. Designed and built by the Lummus Company, this refinery produces straight run, cracked and polymer gasolines, diesel and other fuel oils, all of which are distributed by Western Oil & Fuel Co.

An outstanding feature of this new refinery is its continuous flow operation . . . no intermediate storage tanks are needed between processing stages. This "straight through" design naturally calls for precise, closely integrated control of related processes. To meet these exacting control requirements, refinery and design officials selected Honeywell graphic control.

The big graphic panel shown above combines all the instrumentation for eight different refining processes. Operators can follow the entire functioning of the plant from crude to finished products, from this single control center. Worked out in detail by Honeywell design specialists, this panel does the job that would ordinarily require four or more separate panels. Not only were substantial savings effected in space, but the panel affords complete centralization of plant control . . . flexibility to meet seasonal variations in product demand . . . and maximum efficiency of process supervision, both for operators and for management personnel.

Your nearby Honeywell sales engineer will welcome the opportunity to discuss your graphic control requirements. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4488 Wayne Ave., Philadelphia 44, Penna.

● **REFERENCE DATA: Write for Bulletin 85-20, "Centralized Instrumentation . . . unlimited."**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

This Simple Compressor Meets the Complex Needs of a Changing Petroleum Industry

It's the Nash!

Here is a compressor presenting advantages found in no other device. Nash Compressors have only one moving part, rotating without metallic contact with the pump casing. No internal lubrication is required. Yet they produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure.

There are no valves, gears, pistons, sliding vanes, or other complicated wearing parts in a Nash. Compression is secured by an entirely different principle of operation. Because of this, gas pumping problems difficult with ordinary pumps are often easily handled by the Nash. For example, Nash Pumps are standard equipment in the Synthetic Rubber Industry, where they have met the needs of new and difficult processes.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. They maintain original performance over long periods. Service is assured by a nationwide net-work of Engineering Service offices. Instructive bulletin shows how they operate. Write for it.

- One moving part.
- No internal wearing parts.
- No valves, pistons, or sliding vanes.
- No internal lubrication.
- Low maintenance.
- Slugs of liquid entering pump do no harm.
- Non-pulsating pressure.
- Saves floor space.
- 75 pounds in a single stage.

NASH ENGINEERING COMPANY
274 WILSON, SO. NORWALK, CONN.

If you think your paint jobs are tough

If you place the orders or approve the bills for jobs like this, you know how painting costs break down. And you know that the cost of even the best paint is only a small part of the total—nowhere near what it saves by adding extra years between repainting. That's why so much quality aluminum paint is used for jobs like this.

Because aluminum paint is the first choice for many industrial applications, special formulas have been developed. Paints made to these formulas last longer, cover better, stand up under corrosive industrial smoke and fumes.

If you have plants, structures or equipment that need paint, it will pay you to find out more about the kinds of aluminum paints now available. We do not make paint. But, as the leading suppliers of aluminum pigments to paint manufacturers, we want you to get the best results from the aluminum paint you buy.

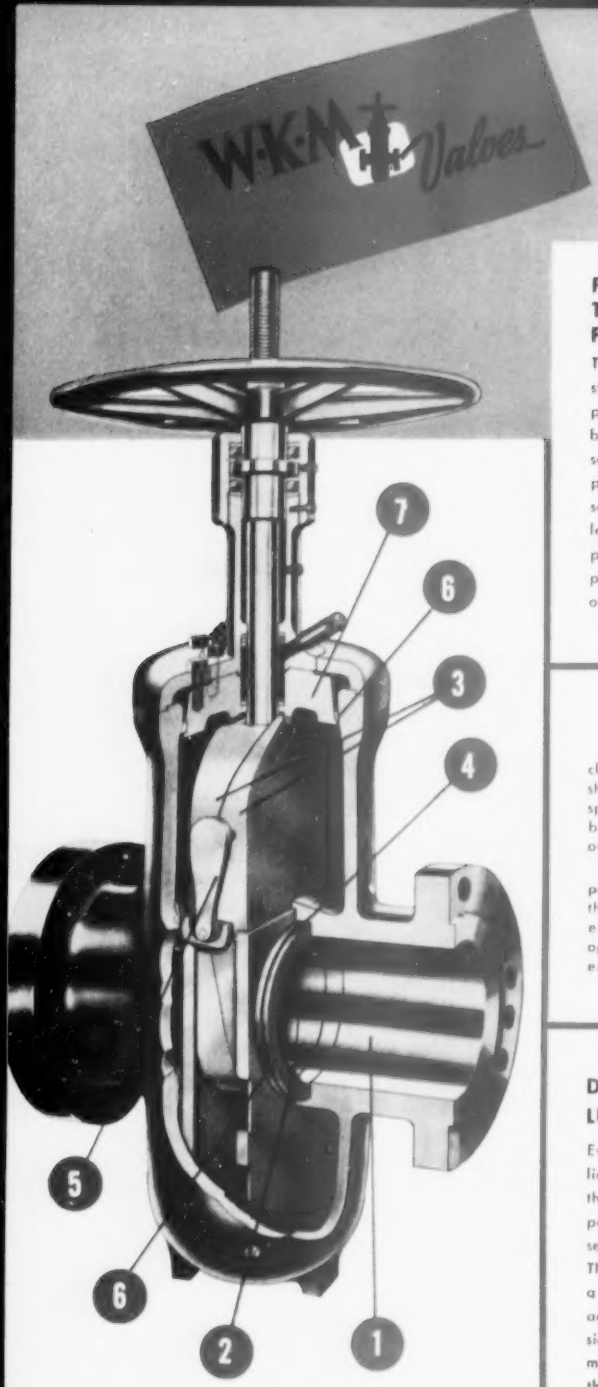
Write us about your paint problems and we'll recommend the kind of paint to use. We'll also send you a copy of *Painting with Aluminum*. It is packed with facts and answers to all types of industrial painting questions. Write Paint Service Bureau, Aluminum Company of America, 1791-J Alcoa Building, Pittsburgh 19, Pennsylvania.

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA

"SEE IT NOW" with Edward R. Murrow—CBS-TV every Sunday . . . brings the world to your armchair. Consult your newspaper for local time and channel.

NO OTHER



FULL OPENING, THROUGH-CONDUIT FLOW

1

The gate and segment construction of W-K-M Valves provides a perfectly smooth bore through the valve the same I.D. as that of the pipe, permitting free passage of scrapers or pigs and maximum turbulence-free flow. In open and closed positions, seats are fully covered and protected against cutting, abrasion or other damage.

REPLACEABLE SEATS

2

The Seats in W-K-M Valves are fully protected from the flow in either open or closed position and are made with an exceptionally large seating area so that they will stand up far longer between overhauls. The seats are press fitted into the valve body and may be removed and replaced (with special tools) while the valve is in the line.

PARALLEL EXPANDING GATES

3

The gate and segment have mating surfaces. While opening or closing the valves, the gate and segment mate at all four surfaces, as shown in Fig. 2, and the width from face to face is smaller than the space between the two seats, thus the gate and segment move freely between the seats, permitting the valve to be opened and closed without wear, sticking or wedging.

In closed position, Fig. 1, the top faces are in contact and the solid portions of the gate assembly are forced against the seats. The width of the assembly is controlled by downward movement of the stem, and an extremely high seating pressure is obtained. When the valve seats in open position, Fig. 3, the bottom faces are in contact and the assembly expands, the width being controlled by the upward movement of the stem.

DIRECT SEAT LUBRICATION

4

Every time a W-K-M Pipeline Valve is operated, a thin film of grease is deposited on the gate and segment at the Wiper Ring. This system of lubrication assures better protection against corrosion and abrasion than ever before and makes it unnecessary to fill the valve body with grease.

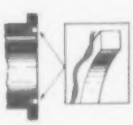
LEVERLOCK OPERATION

5

The Leverlock Assembly is a mechanical device which positively holds the gate and segment in neutral position while the valve is being opened or closed, and permits expansion of the gate assembly at the proper time for seating in opened or closed position. W-K-M is the only valve which uses this positive system of controlling the gate and gate segment.

METAL TO METAL SEAL

6



Under high temperatures or during a fire, W-K-M Valves hold tight whether they are in open or closed position. The metal-to-metal seal insures complete safety under all conditions. There are no "O"-rings, synthetic gaskets or inserts of any kind to burn out and cause leakage.

PRESSURE SEAL BONNET

7

The Pressure Seal Bonnet eliminates bonnet flanges and studs. It is self-adjusting to temperature changes and instead of tending to loosen under pressure as conventional bonnets do, it seals tighter as the pressure goes up.

EASY FIELD MAINTENANCE

8

Any W-K-M Valve may be completely overhauled in the field. When the valve is in closed position, any part of the stem and bonnet assemblies, including the stem, may be replaced. This can be done while the valve is in the line under pressure. The gates, seats, seat skirts and entire operating mechanism may be replaced while the valve is in the line and the pressure is cut off.

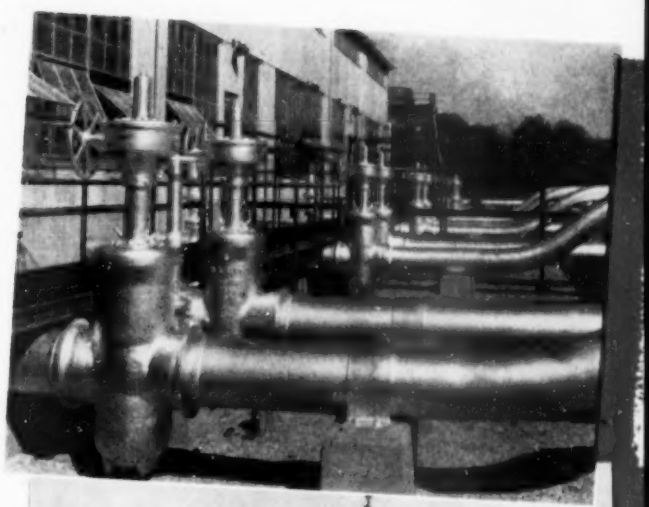
PIPELINE VALVE

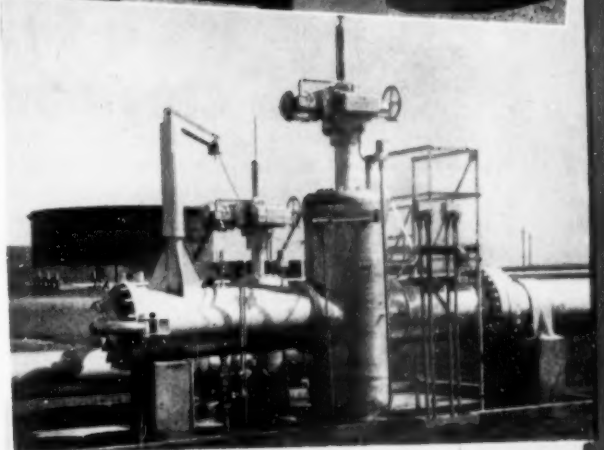
OFFERS SO MANY IMPORTANT FEATURES FOR SAFE, EFFICIENT OPERATION

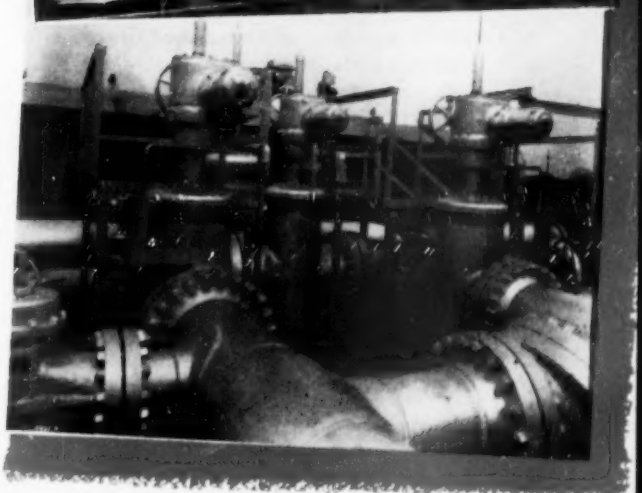
The first W-K-M Valve ever made is still operating satisfactorily after 25 years on the job, and W-K-M Valves installed today will still be in service twenty, fifty or a hundred years from today.

Such is the integrity of W-K-M Valves — the basic rightness of design and extreme care of manufacture — the factors which have made them standard on pipelines the world over.

For complete details concerning W-K-M Valves, write for Bulletin 700-52 or consult your Composite Catalog







W-K-M Valves

W-K-M COMPANY
P. O. BOX 2117 HOUSTON 1, TEXAS
2330 E. 8th St., Los Angeles, Calif.
Export Office: 30 Rockefeller Plaza, New York, N. Y.

it's a faster, easier job with Claymont Welded Steel Pipe

Ease of bending and welding has won outstanding preference for Claymont Welded Steel Pipe on the longest and toughest pipe line jobs.

Every length of Claymont Pipe is made from high tensile steel plate produced in our own plant and carefully controlled through every phase of fabrication starting with the open hearth.

Claymont Pipe bends readily, field-welds fast and uniformly; fits accurately because end bevelling is precision-machined on the most modern end-facing equipment. Uniform size, straightness, roundness and ability to meet the most rigid specifications is assured through hydraulic expansion and exacting hydrostatic testing.

We can supply you with Claymont Welded Steel Pipe in lengths of 40 feet and in overall diameters from 22 inches through 36 inches. Special lengths and diameters can be provided if required. For complete information write or call Claymont Steel Products Department, Wickwire Spencer Steel Division, Claymont, Delaware.

Stainless-Clad Steel Plates . . . Flanged and Dished Heads . . . Carbon and Alloy Steel Plates

THE COLORADO FUEL AND IRON CORPORATION—Denver, Colorado
PACIFIC COAST DIVISION—Oakland, California
WICKWIRE SPENCER STEEL DIVISION—Atlanta • Boston • Buffalo • Chicago • Detroit
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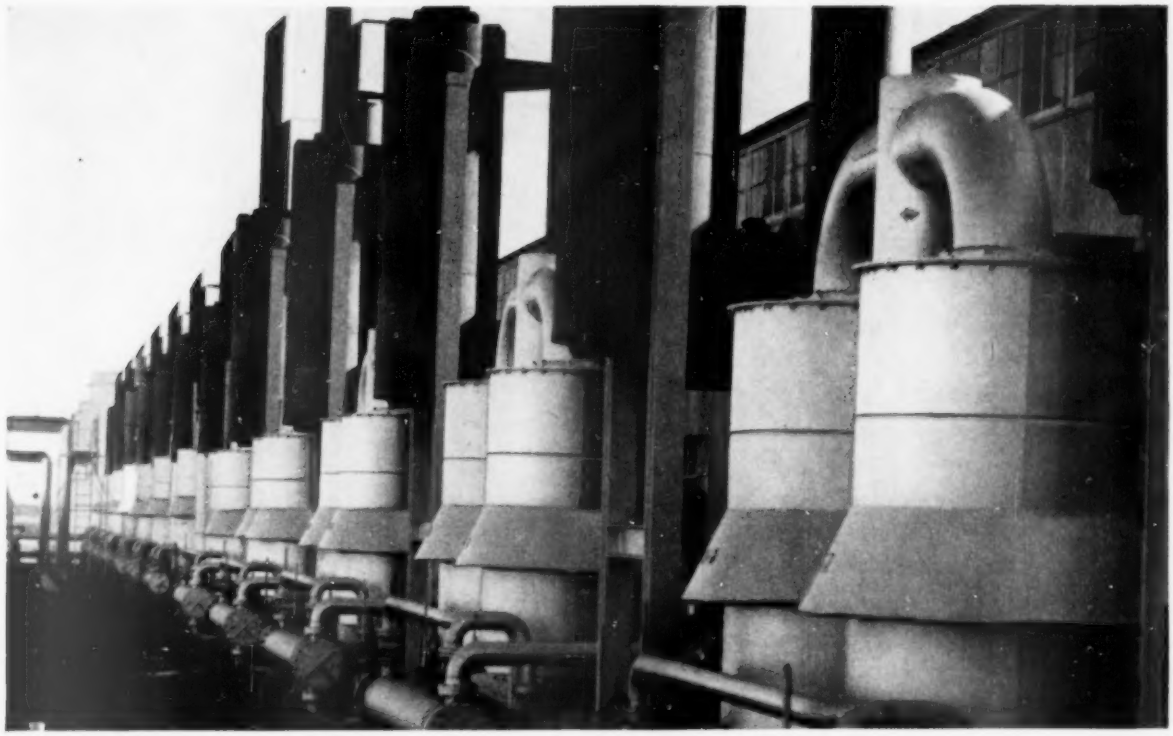
CANADIAN OFFICES: Toronto • Winnipeg • Edmonton • Vancouver

CLAYMONT
WELDED STEEL PIPE
PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION
CF&I

3419



Cycoil "lowers the boom" on DUST

Famous Oil Bath Air Cleaners Supply "Round the Clock" Protection For 17,750 Horsepower

Dust gets rough treatment at this Elk City, Okla. plant of Shell Petroleum. Standing guard at the air intake of each of 10 engines are two Cycoil Oil Bath Air Cleaners.

There's no compromise with perfection when Cycoil is on the job. It battles just as hard for the last particle of dust as the first. The plan of attack is simple, logical and highly effective. First, intake air is thoroughly mixed with oil which traps over 90% of the dust content. Second, final cleaning action is then taken over by dual filter pads which capture the remaining 10%, consisting mostly of those "hard to get" fine dust particles.

Yes, Cycoils deliver approximately 100% clean air. If you settle for less you merely delay the inevitable —costly engine down-time and repairs due to that 2% or 3% of dust that "got by".

Write for AAF Bulletin No. 130. It gives you the "inside" facts on Cycoil design—tells you why this Oil Bath Air Cleaner has become the accepted standard for complete dust protection.

AAF

American Air Filter

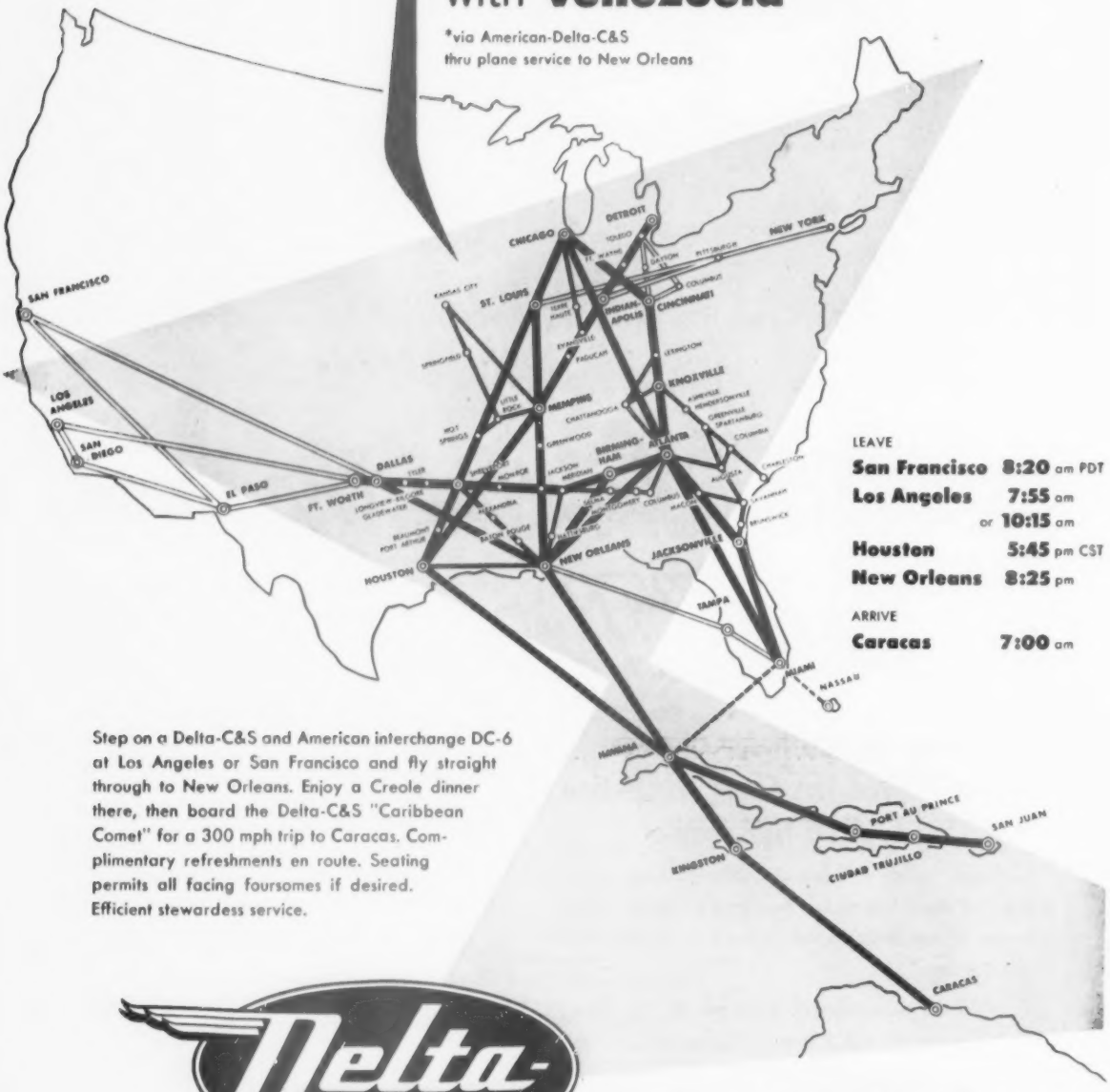
COMPANY, INC.

444 Central Avenue, Louisville 8, Kentucky • American Air Filter of Canada, Ltd., Montreal, P. Q.

DELTA-C&S

Links major oil centers of **California*** and **Texas** with **Venezuela**

*via American-Delta-C&S thru plane service to New Orleans



LEAVE

San Francisco	**8:20** am PDT
Los Angeles	**7:55** am
or	**10:15** am
Houston	**5:45** pm CST
New Orleans	**8:25** pm

ARRIVE

Caracas	**7:00** am

Step on a Delta-C&S and American interchange DC-6 at Los Angeles or San Francisco and fly straight through to New Orleans. Enjoy a Creole dinner there, then board the Delta-C&S "Caribbean Comet" for a 300 mph trip to Caracas. Complimentary refreshments en route. Seating permits all facing foursomes if desired. Efficient stewardess service.

Delta-C&S AIR LINES

General Offices: Atlanta, Ga.

Los Angeles • Phone LOgan 4746
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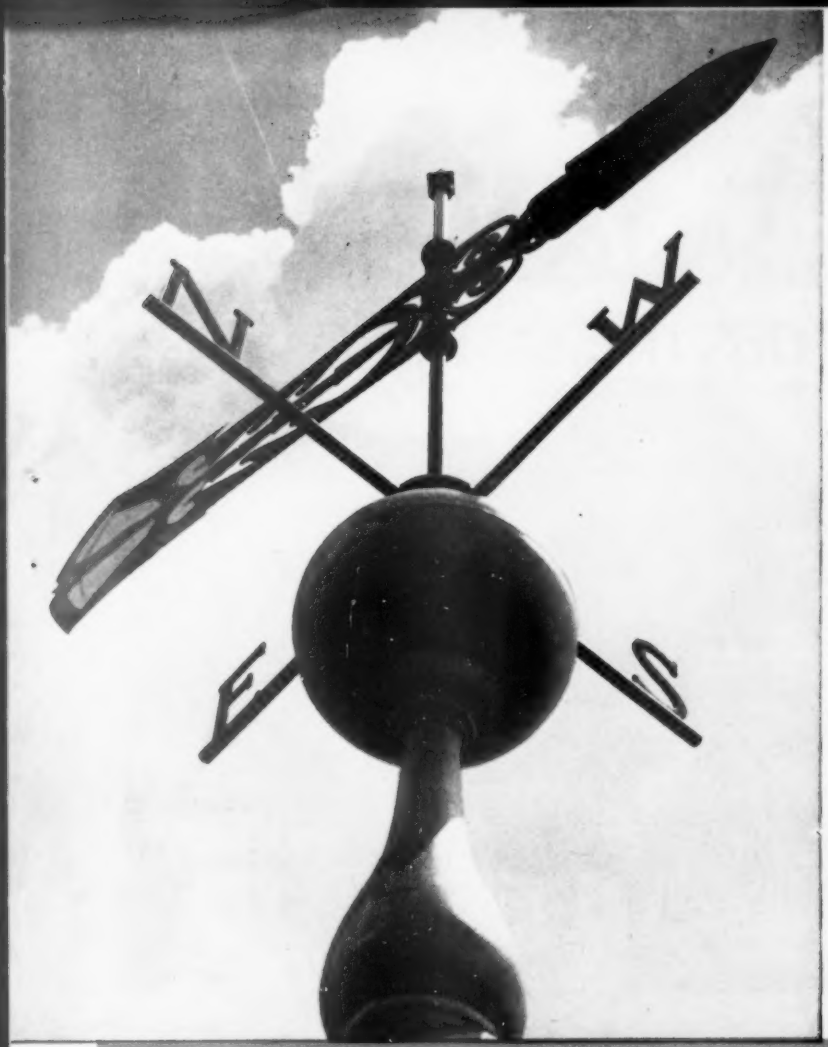


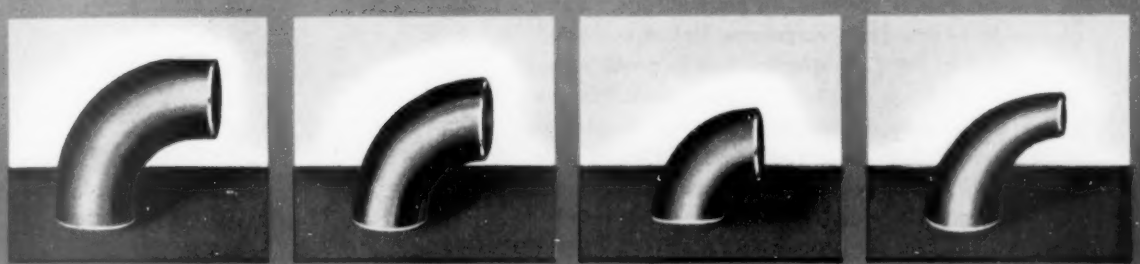
A Four-Way Selection

This photograph of a weather vane seems a good way to point out the fact that there are four different types of Midwest Welding Elbows (see below). These are more types than are manufactured by any other company. This greater selection is important to users of welded piping because it gives the engineer greater latitude in piping design and permits improvements and economies not otherwise possible in welded piping systems. For more information on this subject, ask for Catalog 48.

MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices:
New York 7—90 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—820 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES



MIDWEST "LONG TANGENT"
Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".

ASA STANDARD
Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings, ASA B16.9. Tolerances much less than allowable. Sizes to 28".

SHORT RADIUS
Recommended where space is limited. Sizes to 30". Also available with "Long Tangents" in sizes 14" to 30".

MIDWEST REDUCING
Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.

MIDWEST WELDING FITTINGS

IMPROVE PIPING DESIGN AND REDUCE COSTS

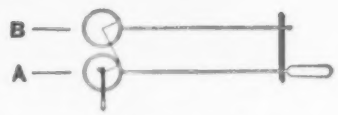
Keep "Weather-Loss"* out of your gas metering

*Weather-loss is the error in metered gas volume caused by temperature variations. Unless corrected, a variation of 10° F. in gas temperature will cause an error of 1% in metered volume. And that can mean big money losses from season to season. With Foxboro Anti-Ambi Temperature Recorders in your line you eliminate these errors . . . you can compute *actual* gas delivery, regardless of weather conditions.

Like all other Foxboro Instruments, Anti-Ambi Recorders are ruggedly built for accurate, trouble-free performance year after year. Weather-tight case allows outdoor installation. Write for complete information.

The Foxboro Company,
609 Neponset Ave.,
Foxboro, Mass., U.S.A.

Here's why Foxboro Anti-Ambi Recorders are more accurate . . .



This diagram shows the Foxboro automatic compensation for ambient temperatures. Measuring and compensating elements are located in the same case, and capillaries for both systems are in the same protective tubing. Compensating system (B) continuously corrects the primary measuring system (A) for ambient temperature changes.

Here's the small-diameter, quick-response bulb used with the Foxboro Anti-Ambi Thermometer. Bulb is made with a stainless steel neck to reduce conduction effects.

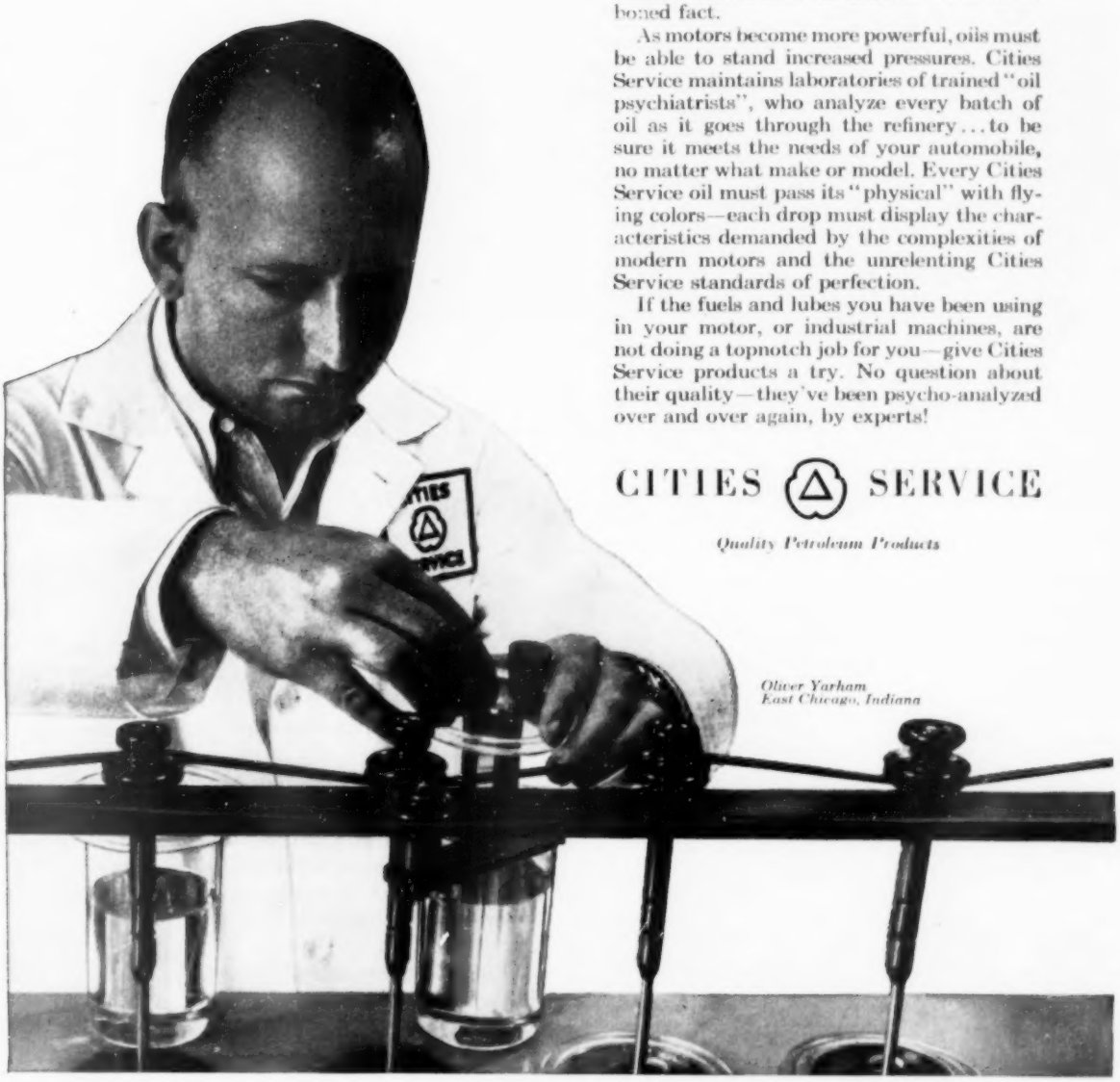
The bulb is generally protected by the special socket shown above. It has aluminum fins for rapid heat transfer, and a stainless steel extension to minimize heat conduction to the socket head.

FOXBORO REG. U. S. PAT. OFF.

Anti-Ambi THERMOMETERS

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

oil goes to a psychiatrist



EVEN OIL NEEDS a psychiatrist these days. Think that sounds farfetched? It is bare-boned fact.

As motors become more powerful, oils must be able to stand increased pressures. Cities Service maintains laboratories of trained "oil psychiatrists", who analyze every batch of oil as it goes through the refinery... to be sure it meets the needs of your automobile, no matter what make or model. Every Cities Service oil must pass its "physical" with flying colors—each drop must display the characteristics demanded by the complexities of modern motors and the unrelenting Cities Service standards of perfection.

If the fuels and lubes you have been using in your motor, or industrial machines, are not doing a topnotch job for you—give Cities Service products a try. No question about their quality—they've been psycho-analyzed over and over again, by experts!

CITIES SERVICE

Quality Petroleum Products

Oliver Yarham
East Chicago, Indiana

Johns-Manville announces a new lightweight, reinforced asbestos pipe line felt . . .

New Transhield Asbestos Pipe Line Felt

. . . designed for low cost tear-free application

Transhield is a lightweight felt, reinforced with continuous glass yarns, parallel spaced on ¼″ centers to give tear-free application strength. Made of coal-tar saturated asbestos, Johns-Manville Transhield Asbestos Felt acts as a continuous barrier to shield pipe line enamels from earth loads and soil stresses.

As an outer sheath to retard cold flow, Transhield takes advantage of the full thickness of the enamel coating—working effectively toward preserving a continuous film of enamel on the pipe line.

Long-Length Rolls—Available in 800-ft. rolls (14″ O.D., 2″ I.D.) for traveling power-driven coating and wrapping machines. Other lengths can be furnished to suit your method of application. Widths are from 2″ to 36″.

• • •

Johns-Manville has developed three wrapping materials for pipe line protection:

J-M 15-lb. Asbestos Pipe Line Felt (perforated or unperforated)—for severe soil conditions.

J-M Transhield Asbestos Pipe Line Felt—for average soil conditions.

J-M Trantex polyvinyl pressure sensitive tape—for pipe line corrosion protection where ease of application is important such as for emergency repairs and for coating field joints of mill-wrapped pipe.

For further information write Oil Industry Department
Johns-Manville, Box 60, New York 16, N. Y.

JOHNS MANVILLE JM PRODUCTS

Johns-Manville ASBESTOS PIPE LINE FELT

Corrosive Valve Services?

try this combination of economy and corrosion-resistance

LUNKENHEIMER "CAUSUL" METAL

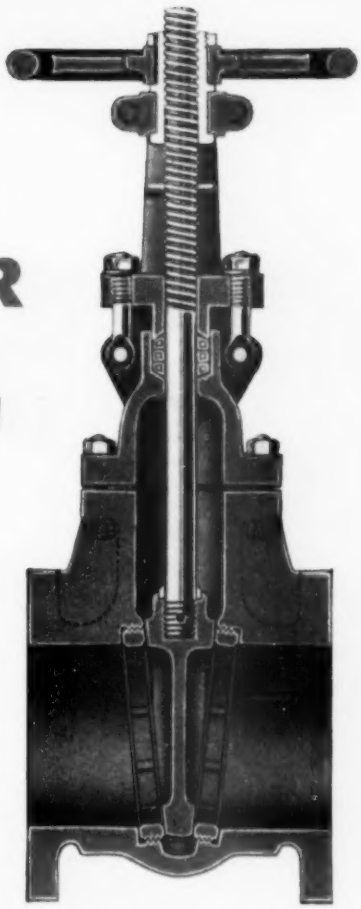


Fig. 1639-8—Gate Monel Trim

Fig. 1847-4—Gate 18-8 Mo Stainless Steel Trim

200 lb. W.O.G.

In corrosive valve applications, trim is a most important factor. If you can get *maximum* corrosion resistance in the trim, combined with *useful* corrosion resistance in a less expensive body, you can save money in most services.

That is exactly the combination you get in "Causul" Metal Valves. Trim is available in either Type 316 Stainless Steel or Monel Metal — providing the best corrosion resistance you can buy. "Causul" Metal bodies and bonnets are less expensive than all-Monel or all-Stainless and *have been used successfully for more than 20 years* in a wide variety of services. They are much more resistant to corrosion than iron valves . . . much tougher, too. And the problems of electrolytic corrosion between seating and body materials do not exist in "Causul" Metal Valves.

"Causul" Metal is an exclusive Lunkenheimer development. Ask your Lunkenheimer Distributor for more details, or write for Circular 592 to The Lunkenheimer Co., Box 360F, Cincinnati 14, Ohio.

Fig. 1708-8—Gate Monel Trim

Fig. 1845-4—Gate 18-8 Mo Stainless Steel Trim

225 lb. W.O.G. Screwed

Fig. 1709-8—Gate Monel Trim

Fig. 1846-4—Gate 18-8 Mo Stainless Steel Trim

175 lb. W.O.G. Flanged

TYPICAL APPLICATIONS

OIL REFINERIES — Sludge and recovery acids, wash liquors, sour crudes, sulphuric acid, caustics, and certain distillates.

COKE AND BY-PRODUCTS — Certain acid and ammoniacal liquors, distillates, agitator service, sulphuric acids and caustics.

WATER TREATMENT — Various water treating solutions, such as soda ash and sodium aluminate. To handle sea water.

PAPER — (Sulfate, Kraft and Soda Processes) — black, green and white liquors.

SUGAR — Raw sugar juice lines.

TEXTILE and rayon processing.

FERTILIZER manufacturing.

CAUSTIC solutions, processing.

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

L-455-15

REPUBLIC

From 2⅜" lines to 30" lines...

Other Republic Products include Casing and Tubing—Carbon, Alloy and Stainless Steels—Studs, Bolts and Nuts—Heat Exchanger Tubes

Electric Weld LINE PIPE...

Electric Resistance Weld and Electric Fusion Weld

Whatever the size of the line you're building, it will go in with a minimum of delays and other difficulties if it's Republic Electric Weld Line Pipe. Everything from a small gathering line to the largest gas line can be specified "Republic"... to your benefit.

The way it's made makes Republic Line Pipe uniform . . . uniformly flat steel is formed into a tube, then electric-welded to produce a uniformly strong pipe. Walls are uniform in thickness to give your crews pipe ends that match-up right, that weld evenly and uniformly. The ductile, low-carbon steel will weld readily, too. High ductility assures smooth, uniform bends in the field or the shop.

Freedom from scale makes the outer surfaces easier to wrap and protect with fewer holidays. Freedom from inside scale prevents loosening of scale after blowing-out, protects instruments and valves from clogging.

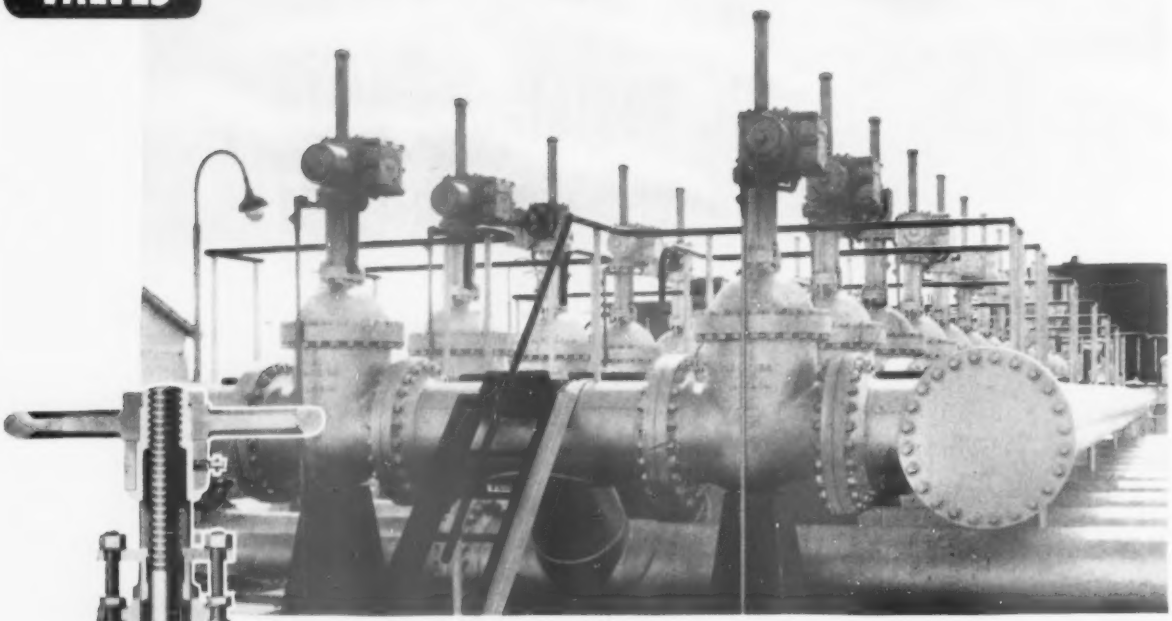
More than 67,000 miles of Republic Electric Weld Line Pipe and 23 years of service for many of these miles help prove that your best investment for transmission, gathering, distribution, and product lines is Republic Electric Weld Line Pipe...either Electric Fusion Weld or Electric Resistance Weld. Literature on both types is available from:

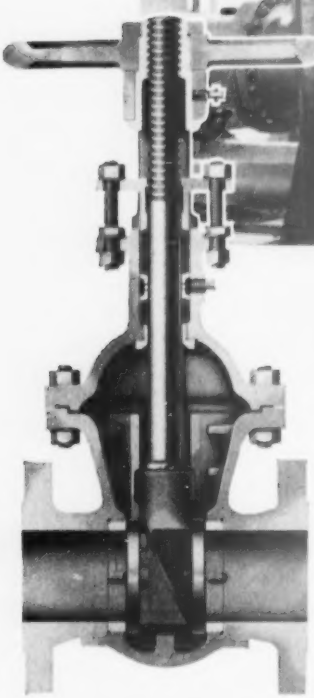
REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N.Y.

Republic
REPUBLIC STEEL
ELECTRIC WELD LINE PIPE
Electric Resistance Weld and Electric Fusion Weld

DARLING VALVES

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN





Cutaway view of Darling cast steel gate valve shows complete simplicity of the fully revolving, double disc, parallel seat principle . . . just four simple working parts . . . two interchangeable, no-pocket discs and two husky wedges. Maintenance is minimized and extremely easy . . . assembly foolproof. And as to all-around behavior . . . it's a perfect natural for pipe line service! Darling pipe line gate valves have full seat opening, same as I.D. of pipe, allowing free passage of line scrapers.

HOW DARLINGS CUT COSTS ..."All along the line"

THE cutaway view shows a gate valve feature that saves no end of dollars and maintenance time in all kinds of pipe line service. It's the *Darling fully revolving, double disc, parallel seat principle* . . . a money-saver, for example, in the 20″ power-operated cast steel gate valves in the pipe line manifold installation pictured here.

On line after line this unique Darling feature proves its time-and-money-saving value because it cinches such important advantages as . . .

1. Positive, easy, tight closing.
2. Automatic adjustment for valve body distortion.
3. Elimination of disc-to-seat galling.
4. Uniform wear distribution.
5. Greater service life with less maintenance.

SEND FOR DATA

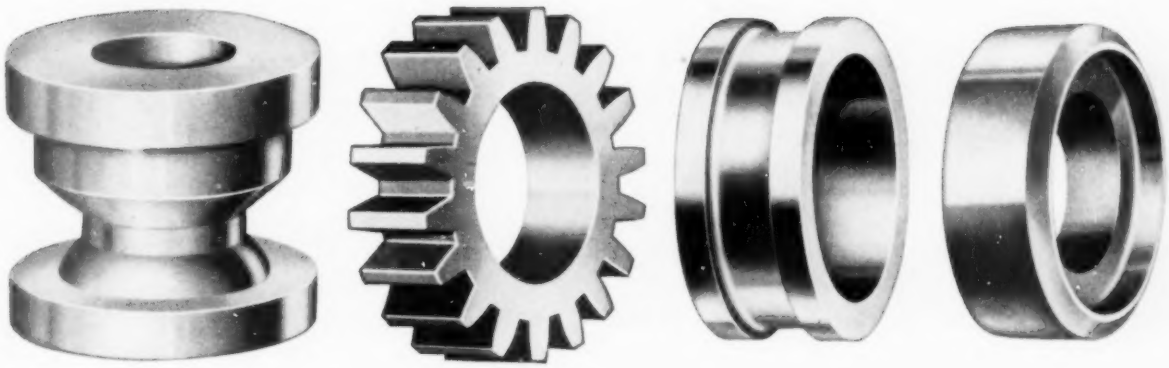
If you don't have *all* the facts on Darling gate valves of this type, it will pay you to look into them. Darling parallel seat gate valves come in a wide range of sizes and constructions for *all* gas and oil line requirements. Simply outline your particular service needs or ask for complete descriptive bulletin.

DARLING VALVE & MANUFACTURING CO.

Williamsport 1, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

If you make hollow parts



why pay top price for the holes?

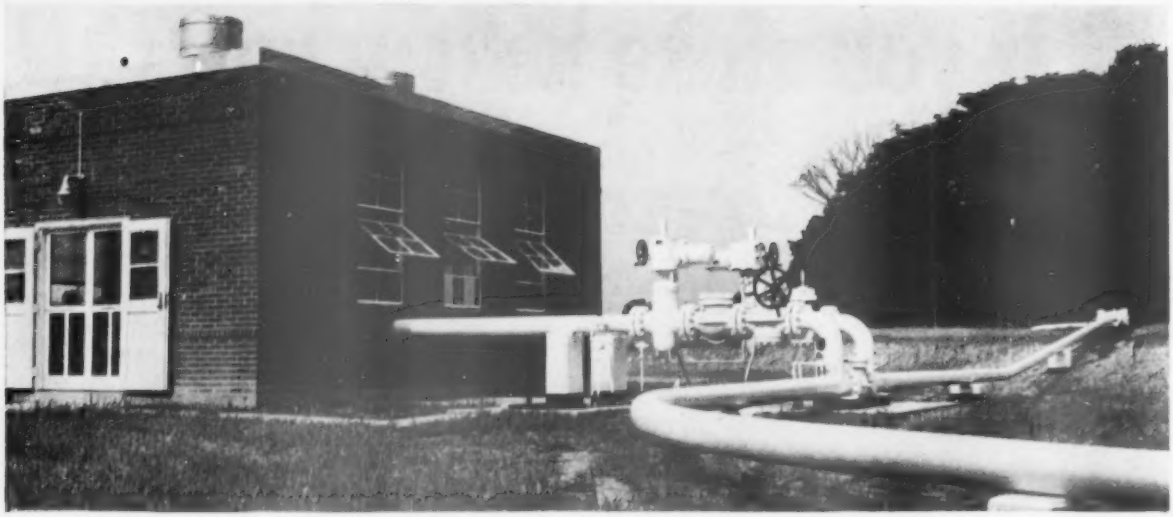
HERE'S a way to save on the cost of the holes in your hollow cylindrical parts. Use Timken® seamless steel tubing. The hole is already there! You eliminate drilling, usually go right into finish boring as your first production step. You machine less metal, get more parts per ton of steel. And the screw machine stations normally used for drilling can be released for other jobs.

And the Timken Company's tube engineering service helps you save even more steel! It recommends the most economical tube size for your job—guaranteed to clean up to your finished dimensions.

You also get fine forged quality in Timken seamless steel tubing. The piercing process by which it is made is basically a forging operation. It gives the tubing a uniform spiral grain flow for greater strength, and a refined grain structure which brings out the best in the quality of the metal. And due to the Timken Company's rigid quality control, this quality is uniform from tube to tube and heat to heat. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING



This Illinois pumping station is controlled by a man in Radio City

When dialed, the pumping station automatically sends its meter readings via teletypewriter to dispatcher in New York.

Shell Oil Company's automatic pipeline pumping station in Dennison, Ill., is supervised and controlled over Bell System lines from an ordinary telephone dial in New York City—more than 800 miles distant!

For meter readings, Shell's dispatcher in New York's Radio City dials a number. Back on the teletypewriter from the Dennison station come suction and discharge pressures and motor current readings.

He dials other numbers to start or stop the pump, open or close valves or to summon an attendant.

This remote-control system keeps the pipeline—which carries 22 different finished petroleum products—operating smoothly from one central location. Dennison is only one of four similarly controlled pumping stations on the line.

Using Bell System communications, you get the benefit of new developments without tieing up capital.

Whether you need private-line telephone, mobile telephone, or teletypewriter service, or channels for remote metering and supervisory control, you'll find research and experience of the Bell System give you the best services available.

Your Bell Telephone Company will be glad to study your communications problems and needs without charge.

PRIVATE-LINE TELEPHONE

TELETYPEWRITER

MOBILE TELEPHONE

METERING CHANNELS

BELL TELEPHONE SYSTEM

One of Four Rockwood Fire Hose Stations at a large refinery.

First aid for burning tanks

The unpretentious box and tank above act as a first aid station for the huge oil tanks in the background.

They're one of four Rockwood Fire Hose Stations at a large refinery. In case of fire, these stations provide much-needed, on-the-spot protection until regular equipment arrives.

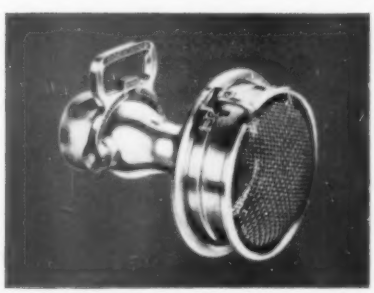
The box contains a 1½-inch In-line Rockwood Eductor, a 1½-inch FFF Rockwood FogFOAM Nozzle with Fog-FOAM screen attached, a 1½-inch Rockwood FOAM Shaper and 350 feet of 1½-inch rubber hose. The tank contains 125 gallons of powerful Rockwood FOAM liquid which, mixed with water and discharged through the FogFOAM nozzle, provides 20,000 gallons of fire-eating Rockwood FogFOAM. What's more, it remains in operation as long as 35 minutes — as against 4-minute fire protection from old style hand extinguishers.

Neat, and compact, Rockwood Fire Hose Stations are another typical example of the way in which Rockwood engineers water to cut fire losses.

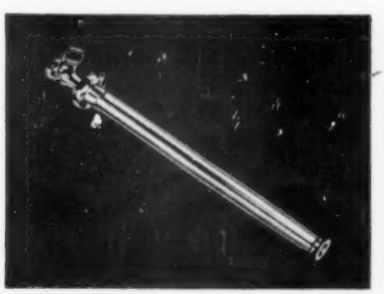
ROCKWOOD SPRINKLER COMPANY

ROCKWOOD *Engineers Water . . . to Cut Fire Losses*

PORTABLE FIRE PROTECTION DIVISION



Rockwood Type FFF FogFOAM Nozzle with FogFOAM Screen. Available for service on 1½", 2½" and 3½" fire hose lines. Discharges FogFOAM, Solid FOAM Stream and High Velocity WaterFOG. Approved by Underwriters Laboratories, Inc.



Rockwood Type FFF FogFOAM Nozzle with Long Foam Shaper. FogFOAM pattern reaches a distance of approximately 20 feet. Solid FOAM Stream approximately 45 feet. Discharges 50 g.p.m. @ 100 psi.

SEND FOR THIS INFORMATIVE BOOKLET

ROCKWOOD SPRINKLER COMPANY
Portable Fire Protection Division
104 Harlow Street
Worcester 5, Mass.

Please send me your illustrated booklet on Rockwood fire-fighting products.

Name.....

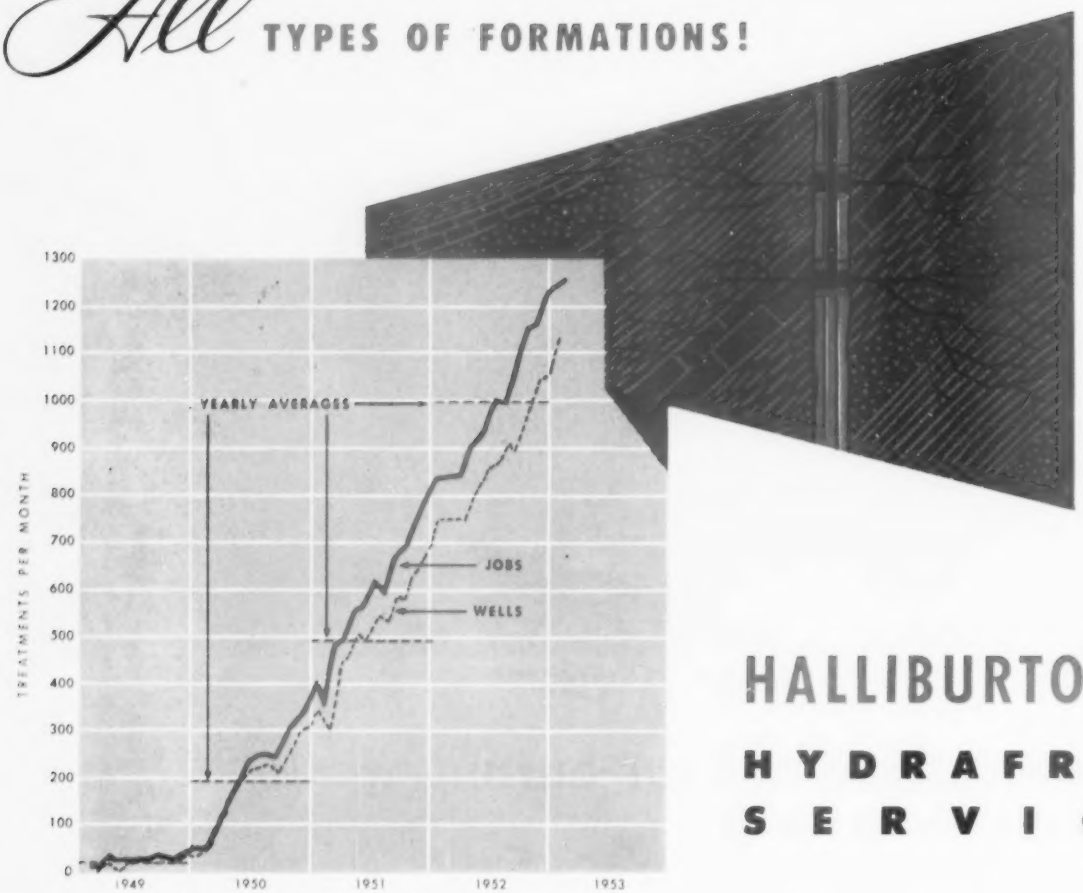
Title.....

Company.....

Street.....City.....

Zone.....State.....

NOW FRACTURES *All* TYPES OF FORMATIONS!



GROWTH OF THE HYDRAULIC FRACTURING PROCESS

HALLIBURTON'S HYDRAFRAC SERVICE

Originally designed for use in sandstone formations, Halliburton's Hydrafrac Service now effectively splits *any* producing formation – high or low solubility – to boost productive flow.

Hydrafrac Service – single and multiple fracture – has been used in thousands of wells since the process became commercially available four years ago. Results have been outstanding. Three out of every four wells treated responded successfully, yielding an average production increase of 175%.

Only Halliburton technicians have the big hard-won background of experience that enables them to determine where this unique hydraulic fracturing service can be used for best results.

To be sure you're getting the most from your well – call in these competent Hydrafrac Service experts – no matter what the formation! Phone your nearby Halliburton representative. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON

YEARS AHEAD IN PRODUCTION IMPROVEMENT TECHNIQUES!

Hydrafrac – Reg. U.S. Pat. Off.

No need to tie up working capital in metal stocks

Here's how you can hold your investment in metal to a minimum, and still protect yourself against costly material shortages. Appoint Metal Goods Corporation your warehouse for all your metal needs.

Many industrial users of metal have discovered this the most logical solution to easing their inventory problems.

If you use aluminum, brass, bronze, copper, monel*, inconel*, nickel*, steel or stainless steel in any commercial form—you'll find Metal Goods Corporation equipped to give you the swift, efficient service that is needed to make a reduced inventory system workable and profitable. Get in touch with your nearest Metal Goods Corporation representative, today. Let him help you plan your course of action.

*Not sold in St. Louis or Kansas City

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Robert W. Downs
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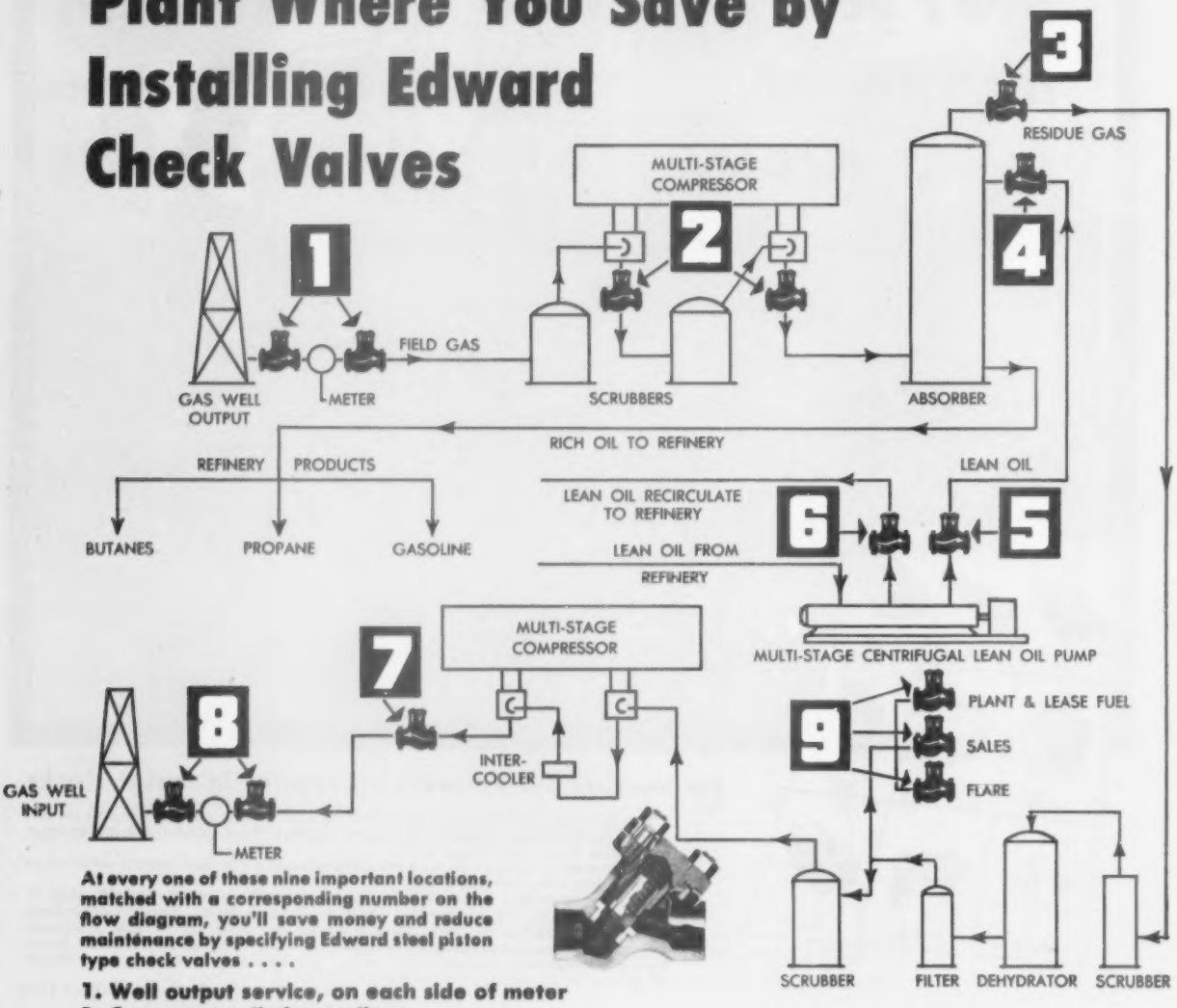
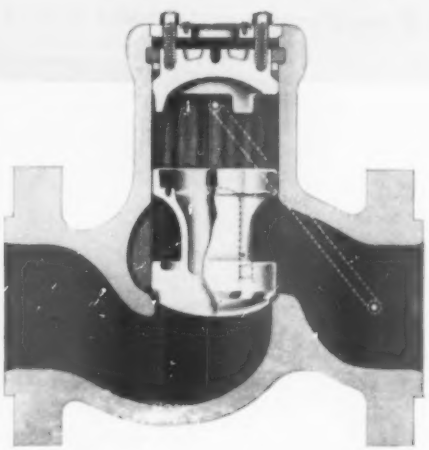
9 Key Points in a Natural Gasoline Plant Where You Save by Installing Edward Check Valves



At every one of these nine important locations, matched with a corresponding number on the flow diagram, you'll save money and reduce maintenance by specifying Edward steel piston type check valves . . . .

1. **Well output service, on each side of meter**
2. **Compressor discharge lines**
3. **Residue gas outlet from absorber**
4. **Lean oil to absorber**
5. **Lean oil pump discharge**
6. **Lean oil pump discharge recirculation to reabsorber in refinery**
7. **Compressor discharge of gas returning to field**
8. **Well input service, on each side of meter**
9. **Stripped or residue gas for internal use, sales to gas companies, or flare**

For any size line in a gasoline plant, for any pressures up to 6000 lb WOG, there's an Edward piston type check valve available. All-steel construction, with stainless steel or Stellite seats and disks. Integral body guide ribs and guide lip on disk centers it tightly on seat. No pipe-jarring slam when the valve closes. With or without piston rings, as the service requires. Full size range in all types of end connections. Write for literature.



Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

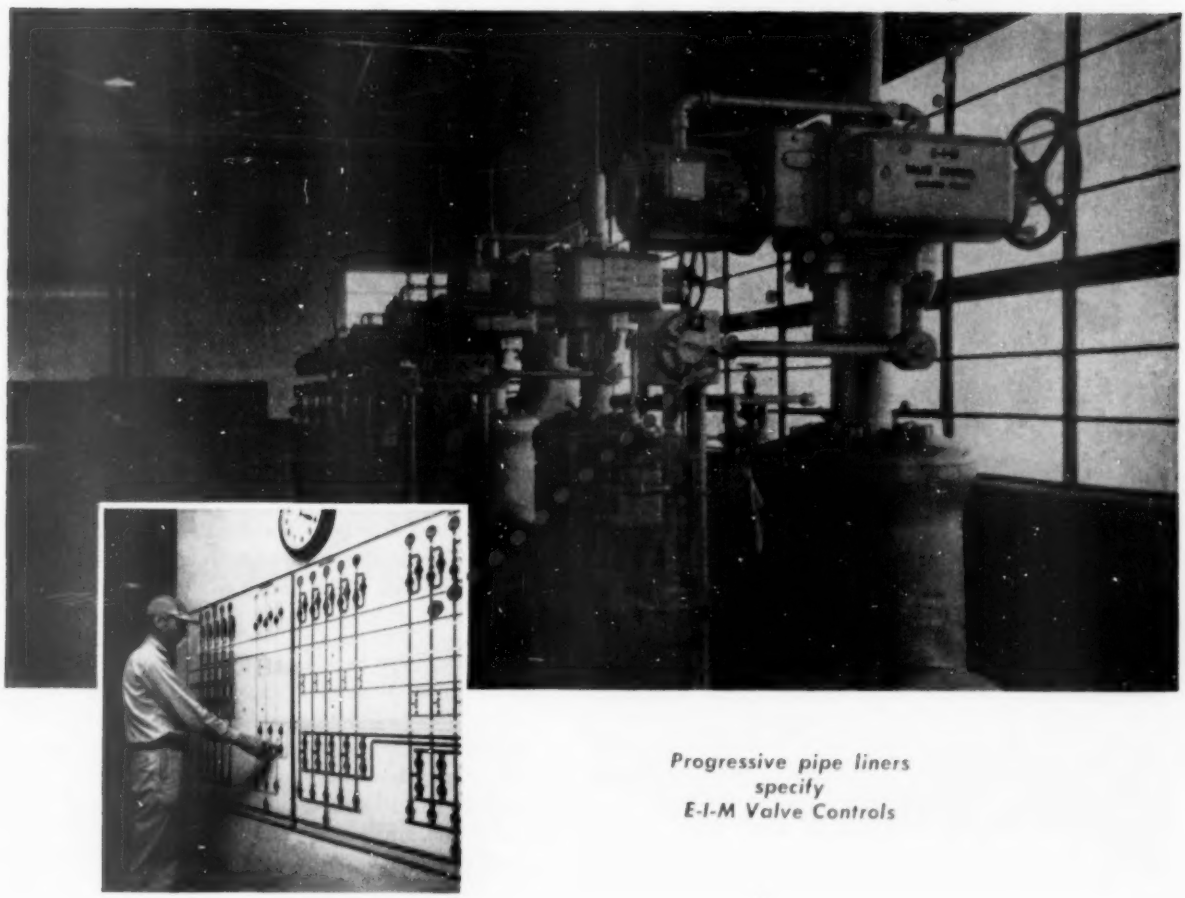
EAST CHICAGO, INDIANA

1492 West 145th Street

Another Rockwell Product

EFFICIENT, INSTANTANEOUS MOVEMENT

West Texas Gulf Pipe Line Co., like many outstanding transmission lines, makes E-I-M Valve Controls the heart of the modern pumping station—striking a single push-button automatically opens the station block-valve and in sequence the pump suction-valve, pump motor, pump discharge-valve



Progressive pipe liners specify E-I-M Valve Controls

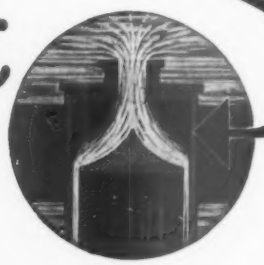
E-I-M Company INCORPORATED

1340 OLD SPANISH TRAIL • HOUSTON 21, TEXAS • MOhawk 4587

Valve Controls • Speed Reducers • Cooling Tower Drives • Control Valves

Dirty Water can't "Shut-down"...

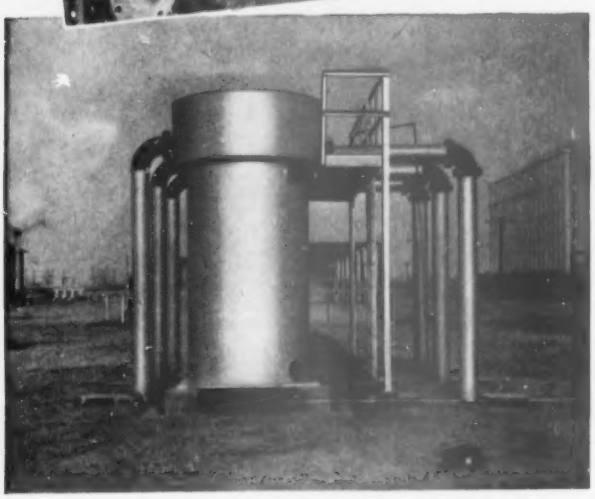
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

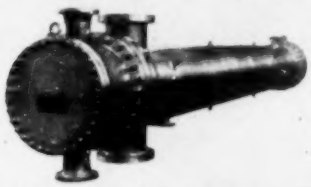
HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

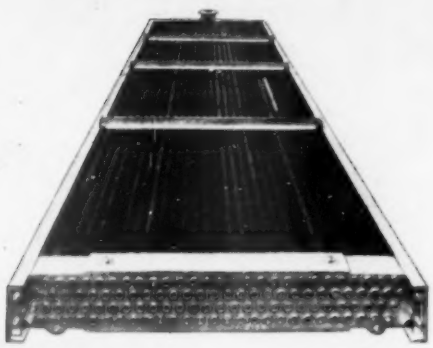
G-R
finned tube
HEAT TRANSFER
APPARATUS

Twin G-Fin Section, used on a greater variety of heat transfer services than any other design of apparatus.

G-Fin Storage Tank Oil Heater, available in designs for installation partly within or entirely outside of tank.



G-Fin Heat Exchanger, for cooling large quantities of gases, or for cooling or heating viscous liquids.

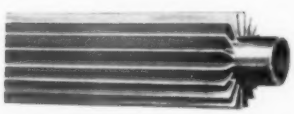


K-Fin Atmospheric Section, used in the Fin-Fan Air-Cooled Exchanger, many hundreds of which are in use all over the world.

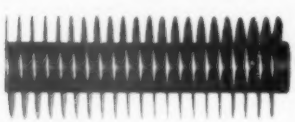
K-Fin Tar-Heated Reboiler, for separation of liquids which do not have close distillation curves.

K-Fin Air and Gas Cooler and Heater, widely used to cool air or hydrogen from generator windings.

Headquarters for Finned Tube Units



G-Fin Element with longitudinal fins



K-Fin Element with helical fins

More than 30 years ago, G-R originated the first finned heat exchanger element that would withstand high temperatures and pressures.

G-R has, since then, developed many additional designs of finned elements and many different types of finned tube units, each for a specific range of services.

Today, the G-R line of finned-tube apparatus covers every heat transfer duty in the petro-chemical industries. These units include vapor condensers, heaters, coolers, and heat exchangers . . . for light, heavy, viscous and dirty liquids, vapors and gases . . . for small and large capacities at low and high temperatures and pressures.

The operating records of the many tens of thousands of installed G-R finned tube apparatus have proved the superior effectiveness, reliability, durability and economy of maintenance of these units. Whatever your heat transfer needs may be, be sure to ask G-R for recommendations.

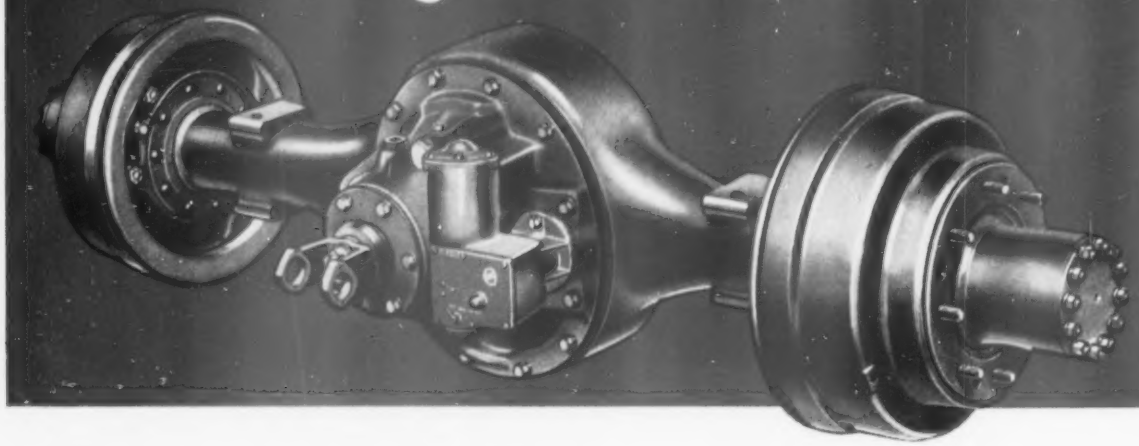
THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

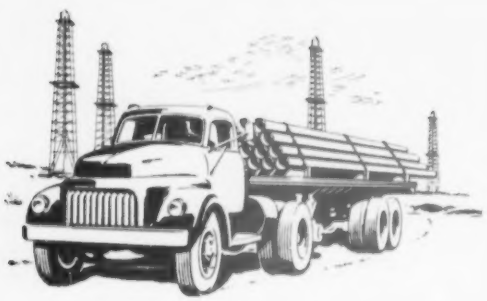
GR 307

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

With Eaton 2-Speed Axles, a cost-cutting gear ratio for every road and load





More than a million-and-a-half Eaton 2-Speeds in trucks today!

Eaton 2-Speeds enable drivers to select the right gear ratio for every operating condition—starting out under full load, climbing grades, high-balling, quick shifting in traffic. Engines operate in their most efficient speed range, reducing stress and wear on vital truck parts. Operating and upkeep costs are at a minimum; trucks last longer, are worth more when traded in. Ask your dealer to explain how Eaton 2-Speed Axles give trucks power when needed, speed when wanted.

EATON

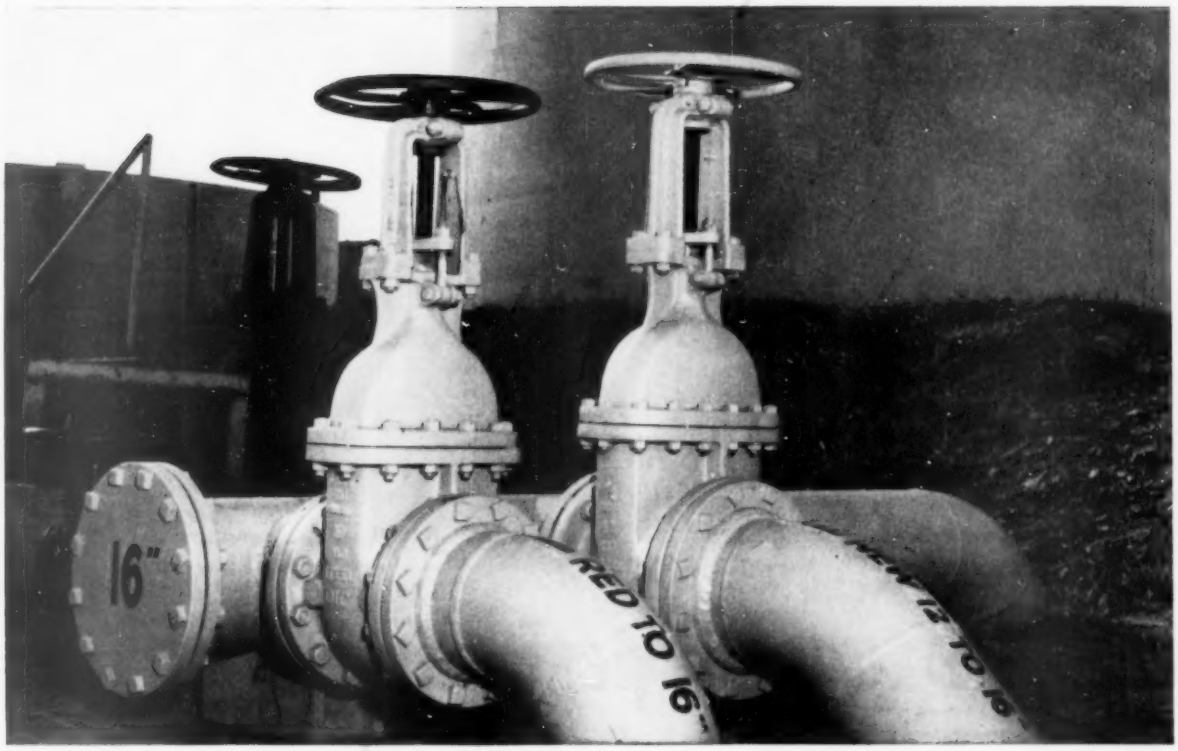
AXLE DIVISION

MANUFACTURING COMPANY

CLEVELAND, OHIO

PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

Oh, I see



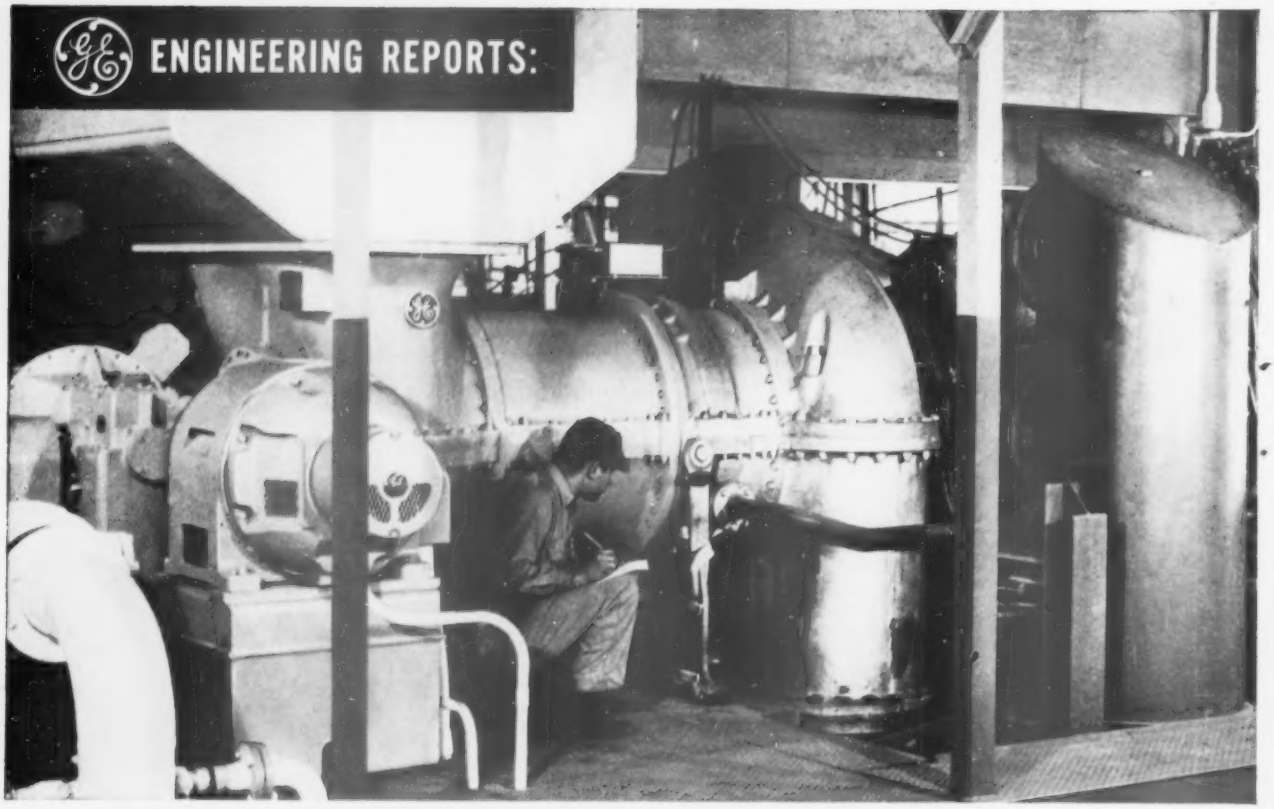
...they're using
our valves at SUNOCO®

Sturdy and dependable, OIC Valves guard the flow at Sun Oil Company. Oil companies throughout the world place similar confidence in OIC Valves. Performance engineered into OIC products can't be beat.

Write for recent catalog information or engineering advice.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

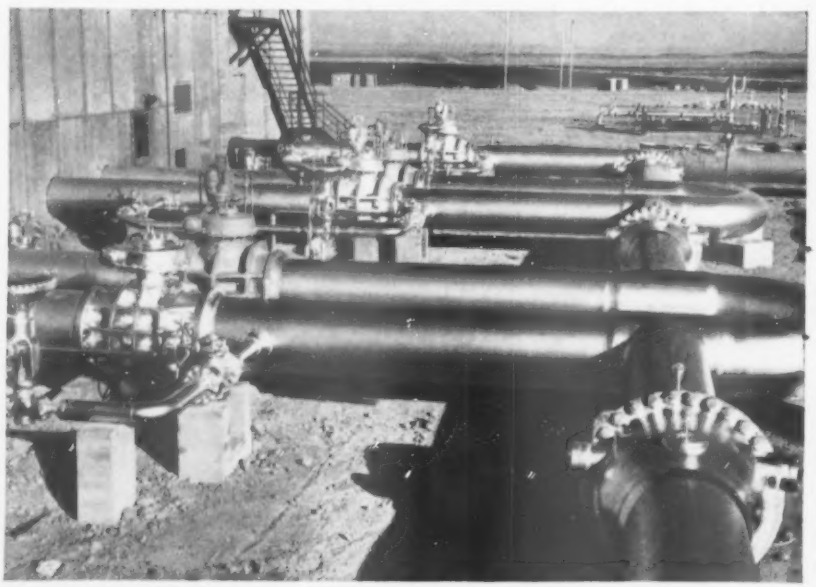
OIC
FOUNDED 1883
VALVES
FORGED & CAST STEEL, IRON & BRONZE,
LUBRICATED PLUG VALVES



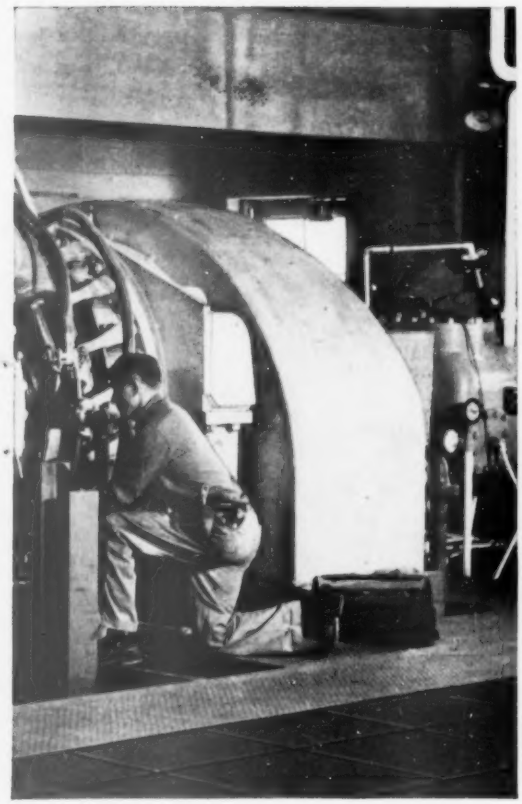
This G-E gas turbine is the first of 28 installed for gas pipeline pumping by the El Paso Natural Gas Co.

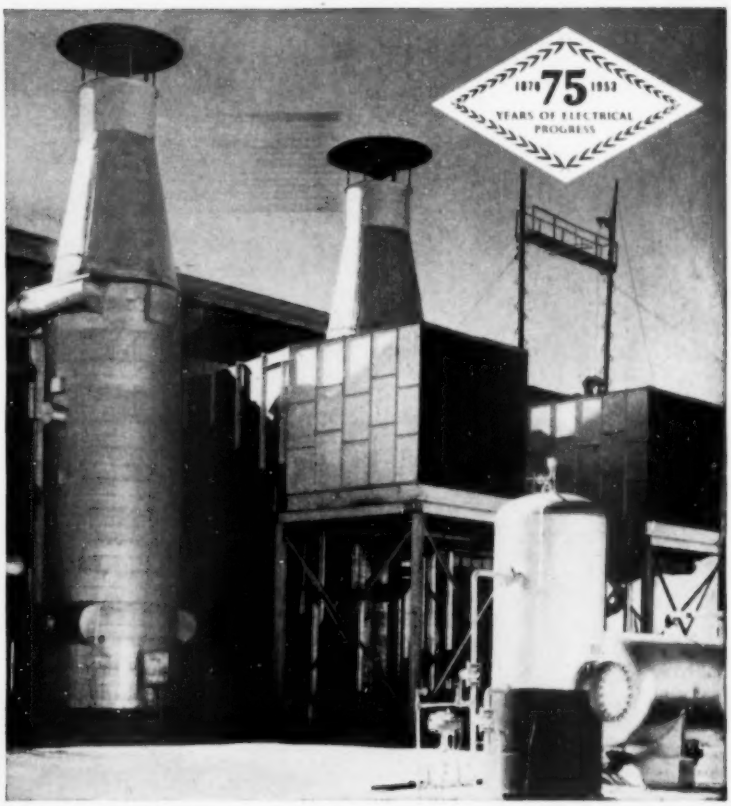
El Paso reports performance of G-E

NO OUTSIDE POWER IS NEEDED — panel above provides control for station auxiliaries. Auxiliary generator, driven by the turbine, provides all a-c power while turbine is operating.



MAIN GAS PIPING is simplified by use of gas turbine-driven centrifugal compressors. The suction and discharge valves, purging and pressurizing valves are all controlled automatically on start. The G-E gas turbine is automatically loaded, and the station discharge pressure is maintained automatically.





HIGHER EFFICIENCY—regenerators "recapture" waste heat, enable turbines to pump with efficiencies comparable to other types of power plants.

gas turbines exceeds expectations

Records of first 15 combustion gas turbines used for pipeline pumping show they start fast, save fuel, simplify operation

So far, El Paso Natural Gas Company has put 15 General Electric combustion gas turbines into operation on their cross-country gas line. Performance has been carefully watched. El Paso has found:

1. **Stations start in 19 minutes—automatically.** Station batteries and pipeline pressures do it all.
2. **Five-man crews can operate stations.** The simple construction of the turbines means reliable performance, easy operation, less maintenance.
3. **Operation proves turbine flexibility.** During nine months of operation under fluctuating conditions, the turbine at Cornudas Station performed with even greater flexibility than had been predicted.
4. **Personnel training system is highly satisfactory.** Key El Paso personnel were sent to the G-E gas turbine plant for intensified training. They in turn trained regular operating staffs. All new positions have been filled by company personnel.

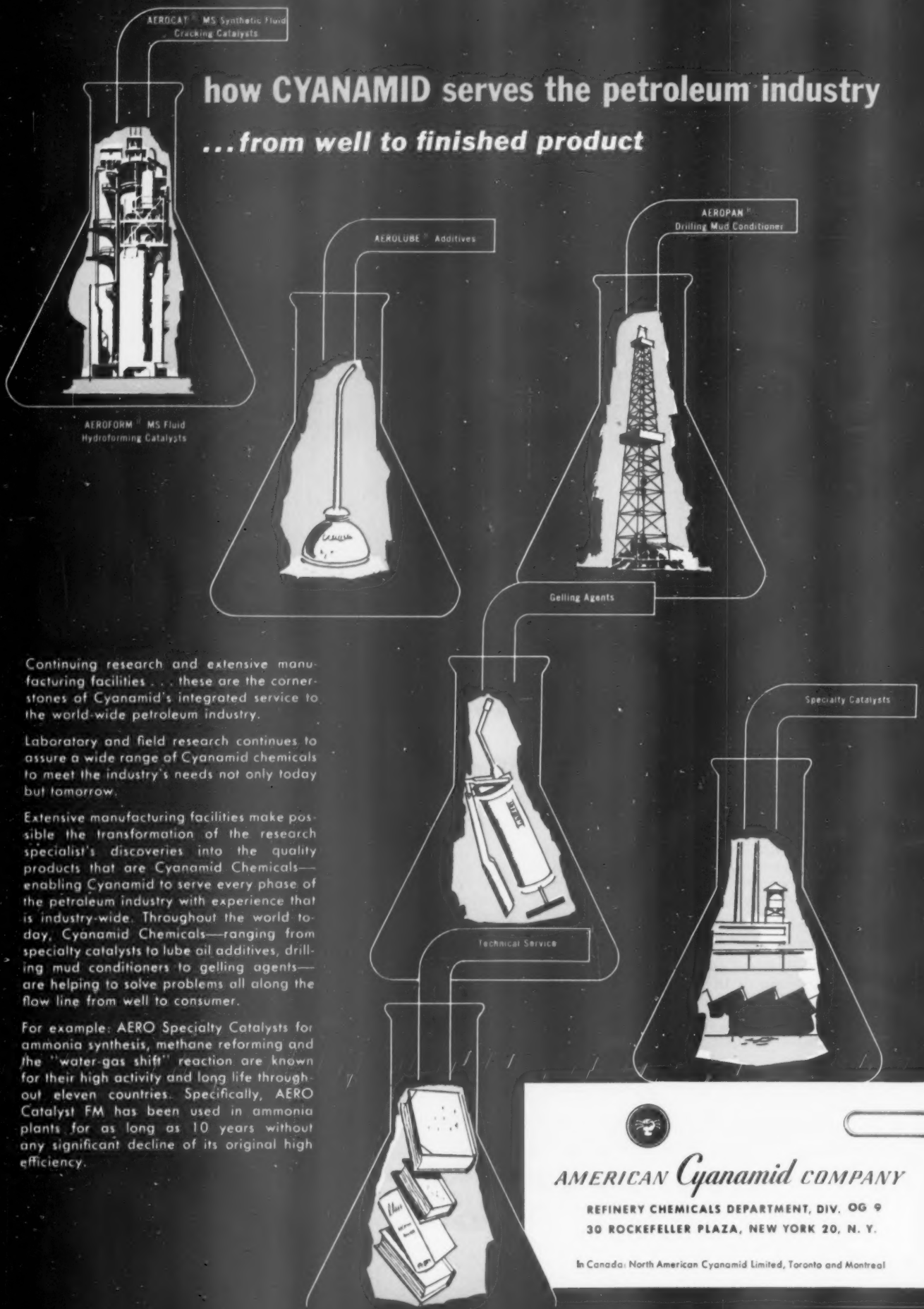
G-E system engineers will be working closely with El Paso engineers during installation of the 13 combustion gas turbines still to go on the line. Your G-E Apparatus Sales Representative can tell you more about their services—and about the G-E gas turbine. Ask him also, to arrange for a showing of the new full-color film, "The El Paso Story," or write to General Electric Company, Schenectady 5, New York. 661-4

Combustion Gas Turbines for the Gas Pipeline Industry—Backed by 45 years of Turbine Leadership

GENERAL ELECTRIC

how CYANAMID serves the petroleum industry

...from well to finished product



Continuing research and extensive manufacturing facilities . . . these are the cornerstones of Cyanamid's integrated service to the world-wide petroleum industry.

Laboratory and field research continues to assure a wide range of Cyanamid chemicals to meet the industry's needs not only today but tomorrow.

Extensive manufacturing facilities make possible the transformation of the research specialist's discoveries into the quality products that are Cyanamid Chemicals—enabling Cyanamid to serve every phase of the petroleum industry with experience that is industry-wide. Throughout the world today, Cyanamid Chemicals—ranging from specialty catalysts to lube oil additives, drilling mud conditioners to gelling agents—are helping to solve problems all along the flow line from well to consumer.

For example: AERO Specialty Catalysts for ammonia synthesis, methane reforming and the "water-gas shift" reaction are known for their high activity and long life throughout eleven countries. Specifically, AERO Catalyst FM has been used in ammonia plants for as long as 10 years without any significant decline of its original high efficiency.

AMERICAN Cyanamid COMPANY

REFINERY CHEMICALS DEPARTMENT, DIV. OG 9

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

Engineered to Out-Perform

...and BUILT TO LAST

• CONTINENTAL •
RED SEAL POWER

HD-260 DIESEL OPEN POWER UNIT. 59 BARE ENGINE HORSEPOWER @ 2000 R.P.M.

For more than 50 years, Continental has been engineering power plants to do more useful work per pound of engine weight, and building them to run longer with less time out for repairs. You do more work, at lower fuel and upkeep cost, with dependable Red Seal power. And the range of the Red Seal line—more than 100 basic models, Diesel and gasoline—assures a power plant engineered to the needs of every job.

Continental Motors Corporation

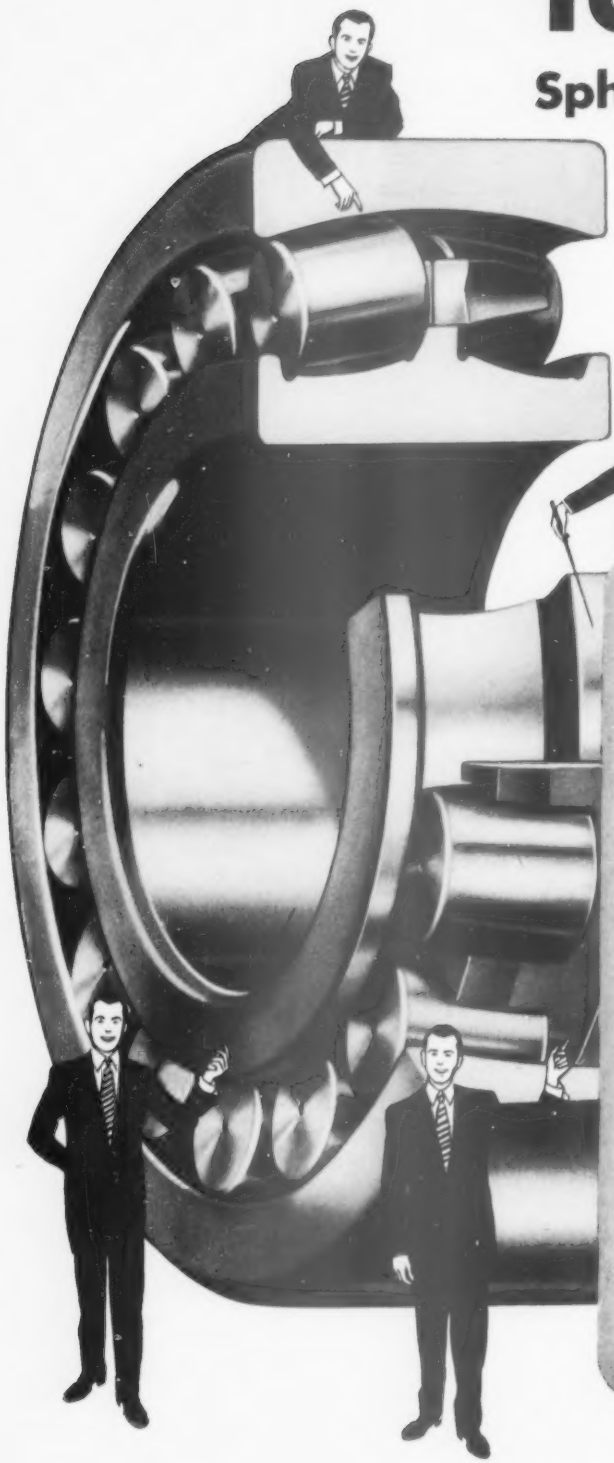
MUSKEGON, MICHIGAN

1819 BROADWAY, NEW YORK 23, NEW YORK • 6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 3817 S. SANTA FE AVE., LOS ANGELES 58, CALIF.
910 S. BOSTON ST., ROOM 1008, TULSA, OKLA. • 1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GA.

TORRINGTON

Spherical Roller Bearings

offer you these basic advantages!



- **Accurate geometrical conformity between races and rollers**—for maximum load bearing capacity at all times.
- **Inherent self-aligning feature**—for continuous service and free-rolling even under shock loads and at sustained speeds.
- **All contact surfaces precision ground from the finest of bearing quality steels**—for minimum friction and maximum life under the toughest operating conditions.
- **Races and rollers heat treated according to the most advanced metallurgical procedures**—to insure uniform hardness in all load-bearing parts.
- **Individual one-piece cast-bronze cage for each path of rollers**—to eliminate roller binding and assure freedom of operation.
- **Radial stability provided by land-riding cage and integral flange on inner race**—to give accurate roller guiding.
- **Unit assembly, with sturdy flange and race construction**—for easy, economical handling during installation.
- **Available from stock with either straight or tapered bore**—for shaft or adapter mounting.

These advantages add up to maximum performance for your bearing dollar. That's why it always pays to specify TORRINGTON Spherical Roller Bearings.

THE TORRINGTON COMPANY
South Bend 21, Ind. • Torrington, Conn.

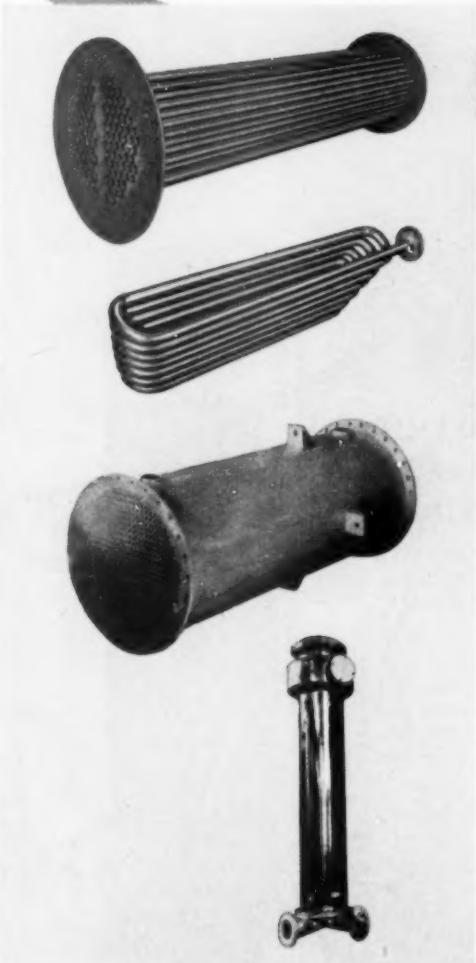
TORRINGTON SPHERICAL ROLLER **BEARINGS**

Spherical Roller • Tapered Roller • Cylindrical Roller • Needle • Ball • Needle Rollers

When the Heat's On*

Exchangers Stay on the Line LONGER

...with *Carpenter* Stainless Tubing



At the left are pictured a group of heat exchangers and heaters in service on widely diverse jobs, in all parts of the country. They have one thing in common —the Carpenter Stainless Tubing that keeps them on the line longer—*when the heat's on for production.

Modern process equipment like this has to stay on the job. You can't afford to interrupt a process for hours or days to replace tubes.

That's why—after considering many sources—more and more orders call for Carpenter Stainless Tubing. They know that the quality standards we set at the mill will safeguard the quality reputation of their equipment.

Analysis, Tolerance and Finish are guaranteed to be "as ordered" on every shipment of Carpenter Stainless Tubing.

Send for this USEFUL SLIDE CHART

Physical properties, sizes and gauges, cross-sectional areas, velocity constants, pressures, weights and other technical data on Carpenter Stainless Tubing for heat exchanger applications are condensed into this handy chart. It's yours for the asking, on your company letterhead.

The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

Export Dept., The Carpenter Steel Co., Port Washington, N.Y.
"CARSTEELCO"

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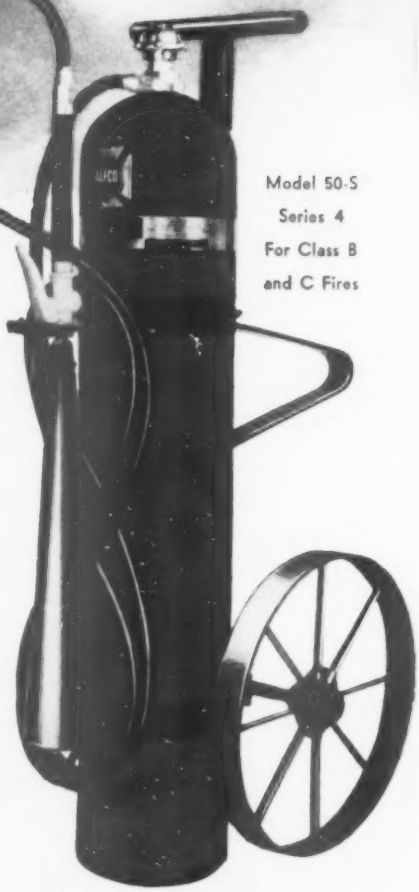

Model 50-S
Series 4
For Class B
and C Fires

FLAMMABLE LIQUID FIRES SNUFFED OUT IN SECONDS WITH MODEL 50-S ALFCO CARBON DIOXIDE WHEELED ENGINES

Lighter in weight, faster in operation, more easily serviced than the heavier model it succeeds, the Series 4, Model 50-S Alfco Carbon Dioxide Wheeled Engine is a one-man fire killer of Class B and C blazes too big for hand portable extinguishers.

It is a trim, streamlined engine, stronger in construction with excellent balance in wheeling position. With a shorter cylinder, but slightly larger in circumference, the center of gravity is lowered and the ease of maneuverability for one-man operation is greatly increased. With a minimum of bulk, it has everything needed for fast and efficient fire-fighting.

The Model 50-S may be operated in an upright or lowered position. The cylinder valve may be opened before or after the hose has been uncoiled at the scene of the fire, but the squeeze lever-type valve on the horn should not be operated until ready to extinguish the fire.

The Model 50-S engine discharge horn is equipped with the exclusive Alfco Anti-Statik Device, to insure complete safety in combating electrical blazes.

Model 50-S is approved by Underwriters' and Factory Mutual Laboratories

Write to have salesman call or for illustrated literature.

Engines Models 100 and 75 are available also

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AMERICAN-LAFRANCE-FOAMITE Corporation

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ALFCO

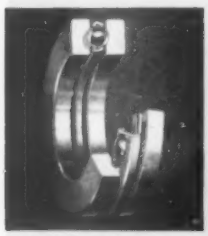
B SERIES • Light duty, one direction ball thrust bearing. Flat seat. Flat races. Bronze ball retainer . . . 38 sizes ½" to 3½" I.D.

C SERIES • Light duty, one direction ball thrust bearing. Flat seat. Flat races. Pressed steel retainer . . . 16 sizes ½" to 1⅞" I.D.

F SERIES • Light duty, one direction thrust bearing. Flat seat. Grooved races. Pressed steel retainer . . . 43 sizes ½" to 3½" I.D.

G SERIES • Medium duty ball thrust bearing. Grooved races. Pressed steel or bronze (large sizes) retainer . . . 76 sizes ½" to 7¾" I.D.

E SERIES • Medium duty ball thrust bearing. Banded. Flat seat. Grooved races. Full complement of balls . . . 40 sizes ½" to 3½" I.D.



1000 SERIES • Light duty ball thrust bearing. Flat seat. Grooved races. Pressed steel retainer. Metric standard . . . 26 sizes 10 to 125 mm. I.D.

1100 SERIES • Medium duty ball thrust bearing. Grooved races. Pressed steel or bronze (large sizes) retainer . . . 23 metric sizes 10 to 140 mm. I.D.

1400 SERIES • Medium duty. Grooved races. Spherical seat. Pressed steel or bronze (large sizes) retainer . . . 23 metric sizes 10 to 140 mm. I.D.

W SERIES • Case hardened and ground flat washers for various Thrust and Spacer applications. Slip fit. 38 sizes ½" to 3½" I.D.

R SERIES • Ball thrust retainer. One piece, pressed steel, channel type cage . . . 79 inch sizes 0.266" to 4.232" I.D.

Just Name Your Need

Whatever mechanized equipment you make or use—whether it is large, small, rugged, fragile, heavy or light—whether it must operate at high speed, low speed, under water, in acid or under extreme temperature or dust conditions, it will do its job better, more efficiently and more economically if bearing equipped. If it is equipment that lends itself to bearing applications of the thrust type—Aetna has the answer or can come up with it pronto. 37 years of thrust bearing know-how assures this. Inquiries invited. No obligation. Aetna Ball and Roller Bearing Company, 4600 Schubert Ave., Chicago 39, Illinois.

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SPECIAL BEARINGS • Facilities for sizes up to 38" O.D. Counsel that brings you the expert technical aid that has licked many of industry's toughest bearing application problems.

PRECISION PARTS • Aetna is versatile—can mass-produce vital parts in almost limitless sizes and shapes—to your most exacting metallurgical, tolerance and finish specifications.

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This is the pipe dream which Canadian Bechtel Limited is fast making a reality. Known as Trans Mountain Oil Pipe Line, it will be moving crude oil to the Vancouver and Seattle areas by the fall of 1953.

Aiding in the completion of this gigantic project is the dependable delivery of Basalt-Kaiser pipe from California.

This is one more example of Kaiser Steel's dependability—one more reason why experienced pipe line companies know that . . .

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Kaiser Steel

KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	14" to 18" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅝" to 12¾" O.D.	Up to 55'	.188" to .375"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	20" to 30" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser

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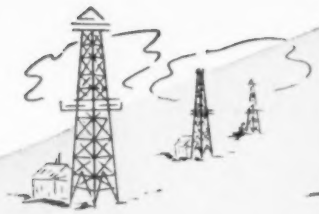
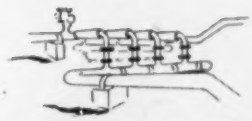


at the wells . . .

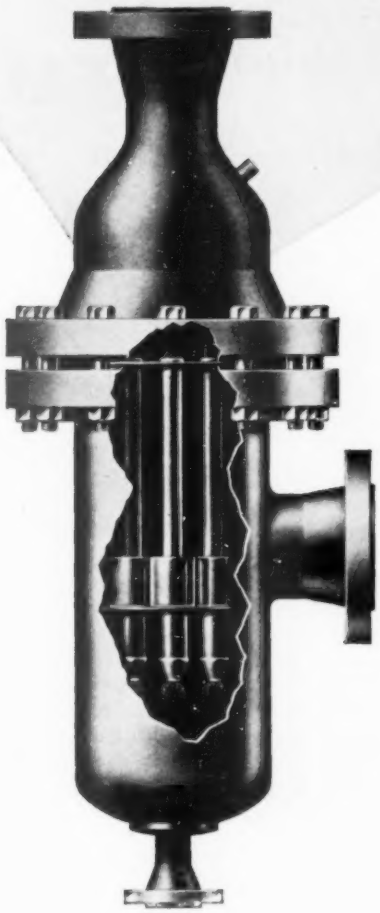


in the pipelines . . .

DRY GAS SCRUBBERS

assure you efficient natural gas cleaning

without liquid filters



Aerotec Dry Gas Scrubbers offer you a highly efficient means of removing dusts and distillates from gas. In the "Big Inch" and many other installations at wells and in pipelines, these units are daily proving the advantages of *dry* scrubbing.

The Aerotec Gas Scrubber uses no oil or other liquid as a filtering medium. This eliminates carryover and other normal disadvantages of conventional type scrubbers. By keeping the gas clean and dry, Aerotec units help prolong the life of compressors and reduce pipeline maintenance.

Aerotec precipitating tubes are the heart of this dry scrubber. Gas passes through these multiple, small-diameter tubes, and the foreign matter is separated from the gas by centrifugal force. Discharge is continuous.

Space-saving compactness, light weight, and piping simplicity of the Aerotec Dry Gas Scrubber permit easy installation. The standard units are available in practically any size up to 100,000,000 SCFD. Manifolding meets needs for larger capacities. Our representative will gladly recommend the Aerotec Scrubbers your specific gas-cleaning problem requires. Call or write today.

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Refinery Engineers:
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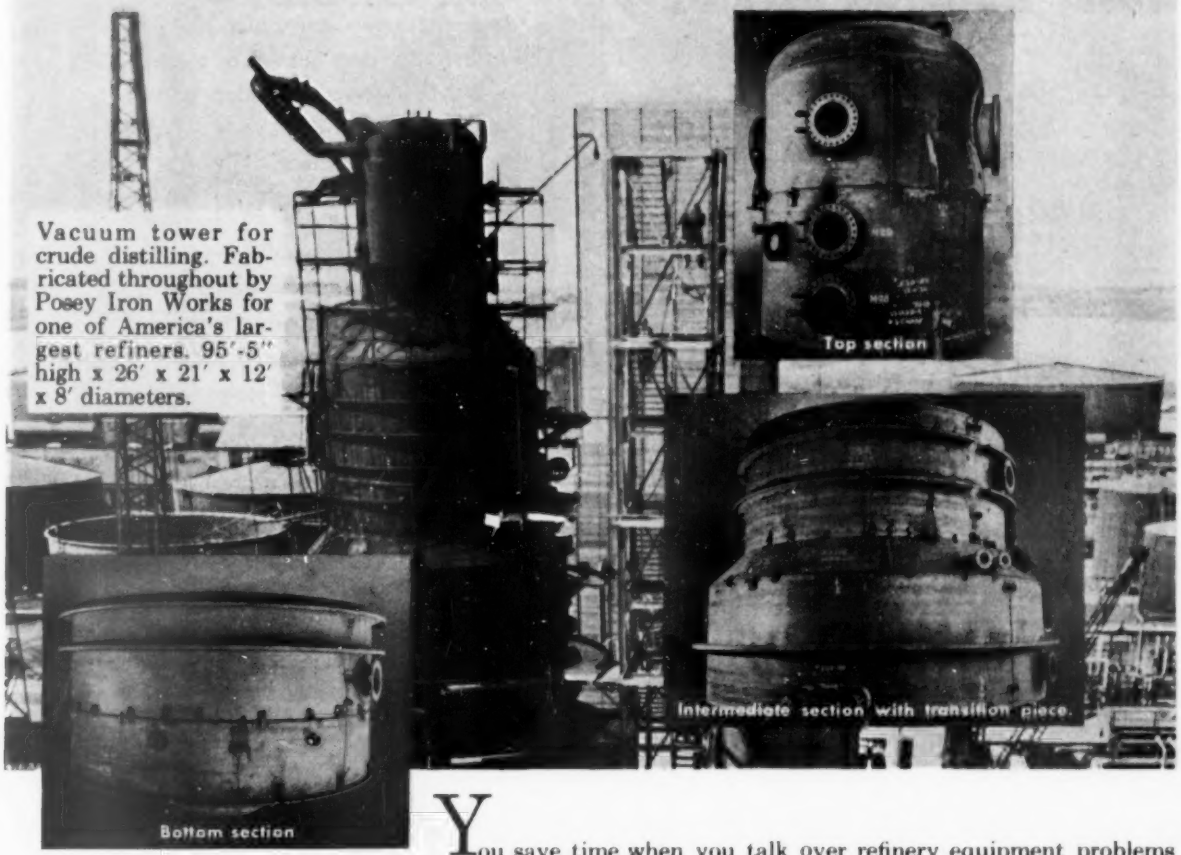

Vacuum tower for crude distilling. Fabricated throughout by Posey Iron Works for one of America's largest refiners. 95'-5" high x 26' x 21' x 12' x 8' diameters.

You save time when you talk over refinery equipment problems with Posey Iron . . . because Posey Iron knows what you're talking about. Long experience in fabricating for the industry has taught Posey's engineers to understand loads . . . pressures . . . capacities . . . sectional construction . . . as encountered in *refineries*.

Posey Iron construction fully meets the ASME and API-ASME codes for unfired pressure vessels. Products are designed and built to comply with the requirements of the ASME; API-ASME and other codes. The Posey Iron Works is authorized to apply the appropriate code symbols.

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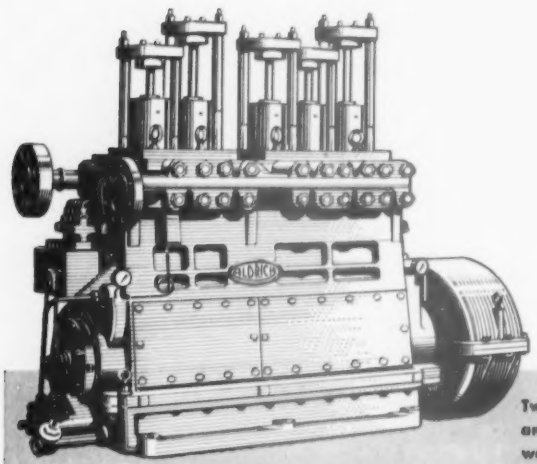
For UNINTERRUPTED water flooding service

. . . it will pay you to use Aldrich Direct Flow Pumps

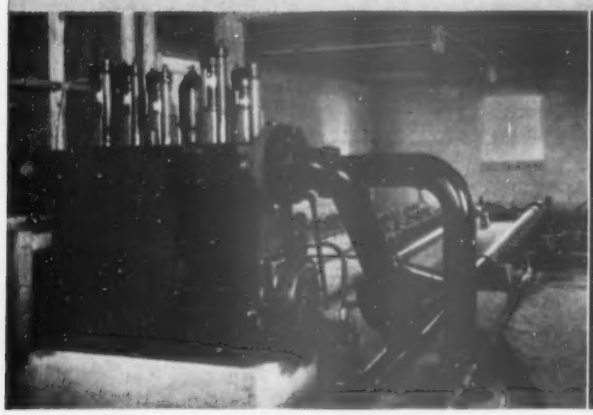


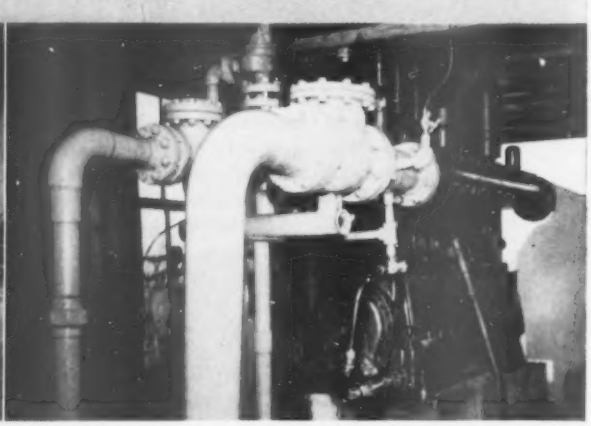
Their record will tell you why. On a large number of water flood projects throughout the country, Aldrich Pumps are providing continuous operation at high pressure . . . critical "musts" in this form of secondary recovery. Operators have found them not only dependable, but also highly efficient.

For water flooding Aldrich can supply you with a pump to meet any volume or pressure requirements you may have. Aldrich Pumps range from a 3"-50 hp triplex, through 5" triplex and multiplex, to the 6" series ranging up to 900 hp.

Get in touch with your nearest Aldrich Representative . . . or write us directly. Data sheets are always available upon request.

Two Aldrich Direct Flow Pumps on the job on water flood operations. At left is an Aldrich 5" stroke motor-driven Quintuplex Pump used for pumping salt water at the Osage #2 property of Winona Oil Company, Flat Rock, Okla. On the right is an installation at Skiles Oil Company, Mt. Carmel, Ill., where a similar Aldrich unit pumps fresh water at 120 gpm against 1450 psi.





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. . . Originators of the Direct Flow Pump

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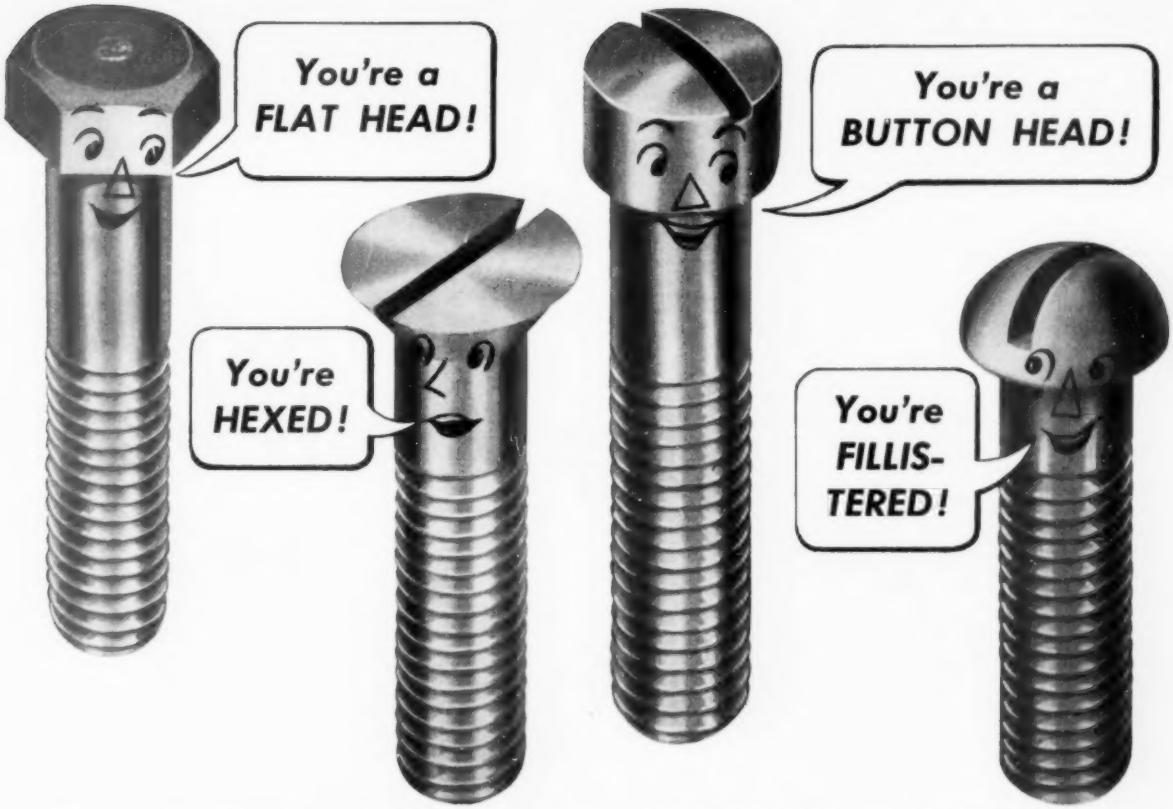


Name Calling Will Get You Top Level Quality in Cap Screws

IF YOU CALL FOR SHEFFIELD

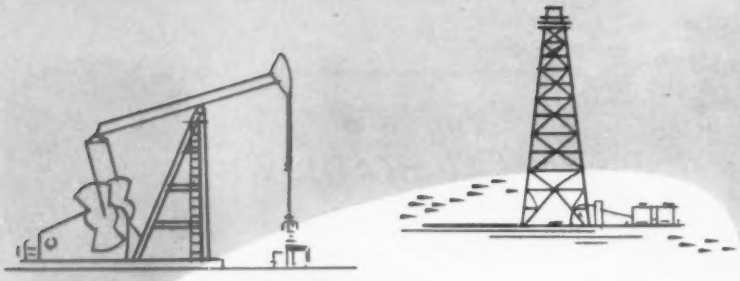
SHEFFIELD

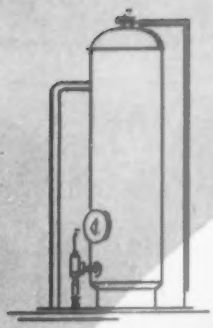
Quality
Starts with SHEFFIELD-Made special Analysis Steel

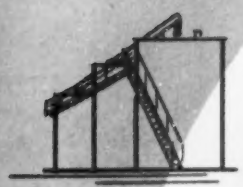
Yes, It Pays to Be Specific. When you ask for Sheffield Cap Screws, you get positive assurance of uniform high quality—quality that starts with special analysis steel, finishes with a product that's rigidly checked and controlled every step of the way.

Careful Inspection all during manufacture makes the big difference. Inspection data is recorded and carefully analyzed by methods similar to those used in aircraft production. This close check makes it easy to maintain Sheffield's high standards.

Proved In Use! Sheffield Fasteners have successfully met every demand placed on them since Sheffield started manufacturing bolt and nut products in 1888. Today, Sheffield offers bolts, nuts and cap screws in thousands of stock sizes, special sizes, coarse and fine threads. Write today for more information on the complete line of Sheffield Cap Screws and other Bolt Products!







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Here's the New J&L PlastiKore Wire Rope You've Heard about!

J&L's new Cable Tool Drilling Line is *still hot news* to oil country men who want a premium product at no extra cost.

J&L's PlastiKore Wire Rope has been tested and proved in actual jobs under a wide variety of acid and corrosive conditions. And here is what it means for you:

1. It resists acid and other corrosive conditions.
2. Does not absorb or retain moisture.
3. Provides permanent support for strands.
4. Has a more uniform diameter.
5. Protects against internal corrosion.
6. Retains flexibility.

For more information call your nearest J&L Distributor. He's ready to show you samples and give you complete, efficient service.

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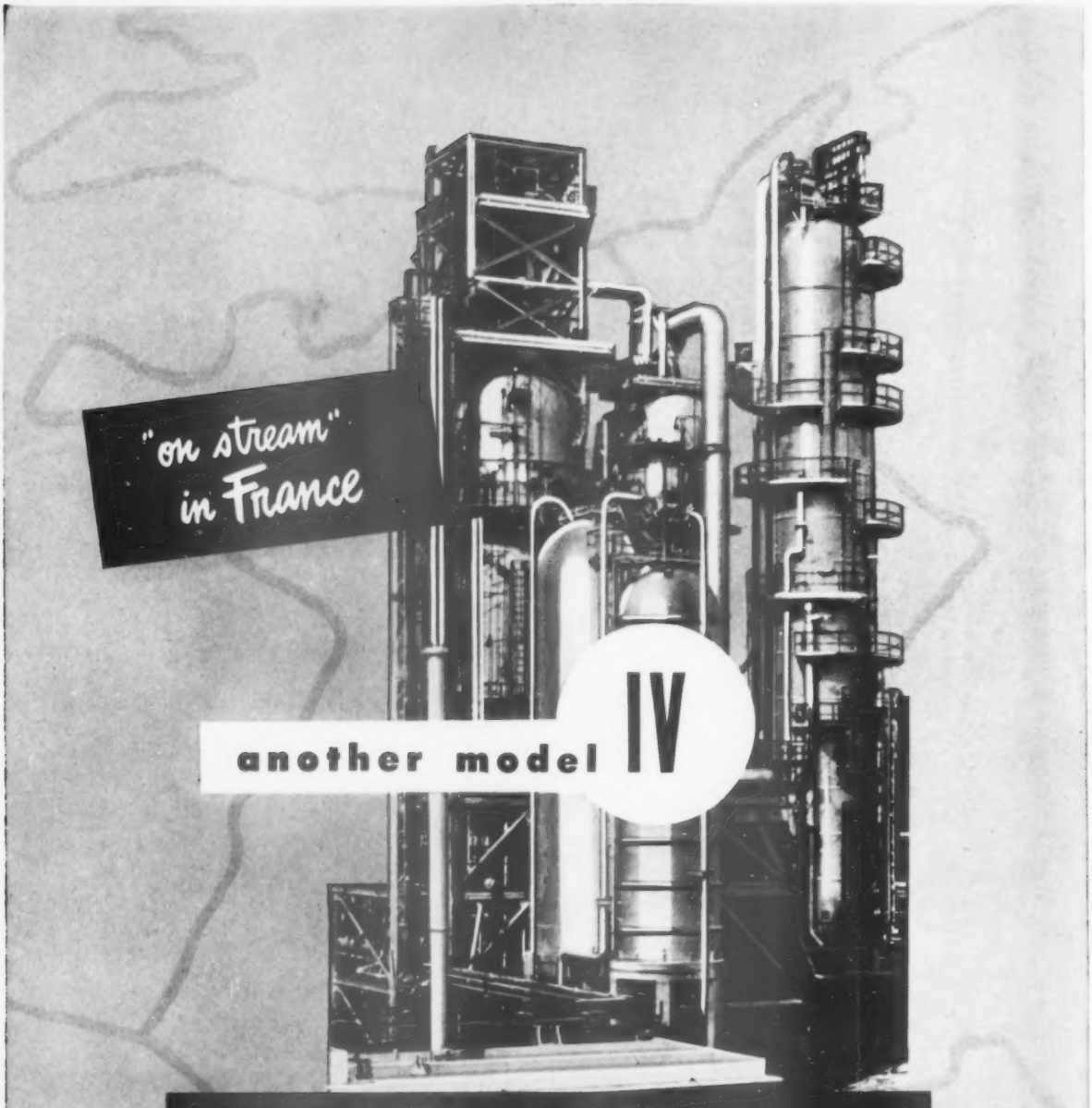

At the Port Jerome refinery of Esso Standard Society Anonyme Francaise' on the River Seine between Paris and Le Havre, one of the first Model IV Fluid Catalytic Cracking Units in Europe was placed "on stream" this month.

It is the second Model IV unit to be completed by Foster Wheeler. A third unit is currently going on stream in Massachusetts and four more are in various stages of design and construction.

Another reason why

Chase

Antimonial Admiralty Tubes last longer!*

(a patented alloy)

Yes, you can *count* on Chase Antimonial Admiralty Heat Exchanger Tubes to give you many years of satisfactory service.

Chase Heat Exchanger Tubes are rigidly controlled for quality during manufacture, and various tests are applied when the tube is finished. The flattening test mentioned below is a good example. Wall thickness, diameter, surface finish, concentricity and accuracy of length are carefully determined.

So, for Heat Exchanger tubes that last and last, *remember:* insist on Chase Antimonial Admiralty!

*U.S. Pat. No. 2,061,921

PUTTING THE SQUEEZE ON IMPERFECTIONS...
This Chase technician is performing a "flattening test" which is an indication of soundness and freedom from hidden defects. You are assured that tubes passing this test will satisfactorily withstand bending or end flaring.

Chase BRASS & COPPER

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Buy the Trouble-Free OIL FIELD ENGINE

MINNEAPOLIS MOLINE
MM
MODERN MACHINERY

5 big advantages for continuous duty and long life

- EXTRA HEAVY CONSTRUCTION
- STANDARDIZED QUALITY CONTROLLED PARTS
- SLUDGE-FREE OPERATION
- UNIFORM OPERATING TEMPERATURE
- PIONEER OIL FIELD APPLICATION EXPERIENCE

Length of engine life is determined by the stamina built into the parts. By comparing the weight and size of parts you can calculate how long they will last and give trouble-free continuous service.

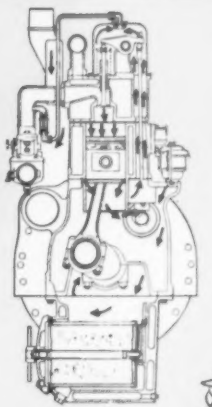
MM heavy-duty oil field engines have large diameter crankshafts, generous bearing surfaces, and heavy flywheel housing flanges that prevent deflection. Cylinder heads, removable cylinder blocks and crankcases are of thick wall design that eliminates distortion.

It is this extra margin of size and strength built into MM parts that makes them *stay put*, and makes MM engines stay on the job *longer!*

To back up this heavy-duty design under severe operating conditions, MM oil field engines have exclusive hot water jacketed base pans and metered vacuum crankcase ventilation. These features are proved by 10 years of continuous operation without major overhaul.

Get the facts about how these features prevent sludging and maintain uniform top to bottom temperature control under extremely unfavorable fuel and climatic conditions. Other MM cost-reducing features you will appreciate are the many standard parts, interchangeable on all power sizes that make possible finest precision and require minimum spare part stocks.

Quality Control IN MM FACTORIES ASSURES DEPENDABLE PERFORMANCE ON THE JOB



Minnie Moline's reminder: "*MM exclusive base pan and crankcase ventilation assure trouble-free operation.*"

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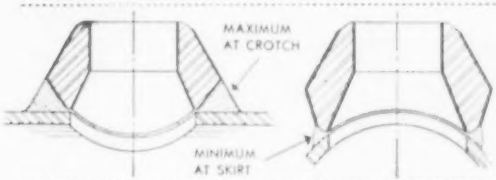
WELDOLET WELDING FITTINGS
MEAN PERMANENT PIPING
. . . PERMANENT SAVINGS

Here's Why

Every fitting is shaped to fit the pipe and is self-aligning.

The template is the inside of the fitting. The hole in the run-pipe can be cut out either before or after the fitting is installed.



Welded as indicated—to fill in 50° bevel at crotch, blending into 35° bevel at skirt—full reinforcement is accomplished.

The outlet is machine-beveled for quick, easy butt-welding of the branch pipe—shop or field fabrication.

Here's How

1. The WeldOlet is raised off the run pipe to establish proper weld gap, as required by Code for all types of branch connections. This is accomplished by placing spacers, e.g. welding rods, under the fitting.
2. The base joint is tack welded, preferably at four points, each half way between the crotch and skirt sections of the fitting. The spacers are then removed.
3. The stringer bead—or beads—is applied completely around the base of the fitting. The established weld gap assures full penetration.
4. Additional passes are applied as necessary to fill in the tapered base bevel of the fitting. The intermediate passes should not be continuous. Re-inforcing welds should be made at the crotch bevel area at each side of the fitting only. A continuous cover bead should be added, filling the bevel at the base of the fitting at the crotch and skirt sections.

TO COMPLETELY SAFEGUARD AGAINST:

- high pressures
- high temperatures
- internal corrosion
- external stresses

TO PROVIDE:

- improved fluid flow
- trouble-free and permanent piping systems

TO ACCOMPLISH ALL THESE THINGS IN THE MOST ECONOMICAL MANNER . . . SPECIFY AND USE

BONNEY WELDOLET WELDING FITTINGS

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WELDING FITTINGS DIVISION

BONNEY FORGE & TOOL WORKS

ENG. DEPT., 366 GREEN STREET
ALLENTOWN, PENNSYLVANIA

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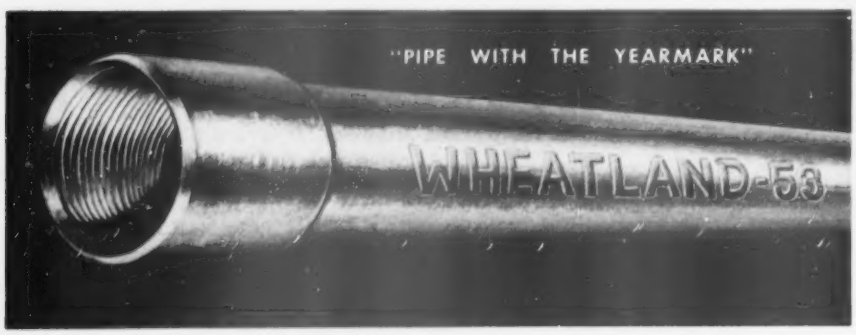
"Built-in" endurance

That tough shell is nature's protection for the turtle. For man-made protection at its best, specify Wheatland steel pipe. "Built-in" endurance is assured by rigorous inspection from selection and testing of raw skelp to final hydrostatic tests. For strength and endurance, select "the pipe with the yearmark."



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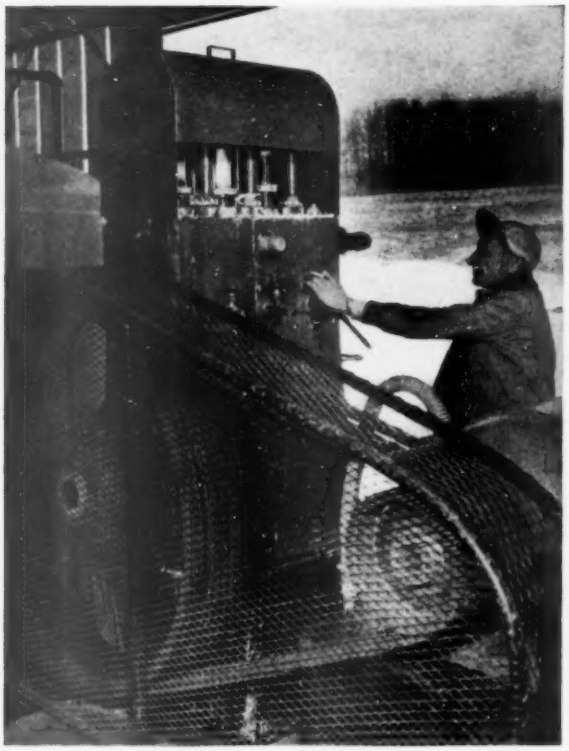
BANKERS SECURITIES BUILDING, PHILADELPHIA 7, PA.



QUICK SHEAVE CHANGES for maintenance of this water flooding equipment are easy when the QD is used. The hub stays put, permanently aligned and only the rim comes off when the heavy assembly bolts are used as jack screws. Re-assembly is just as easy.

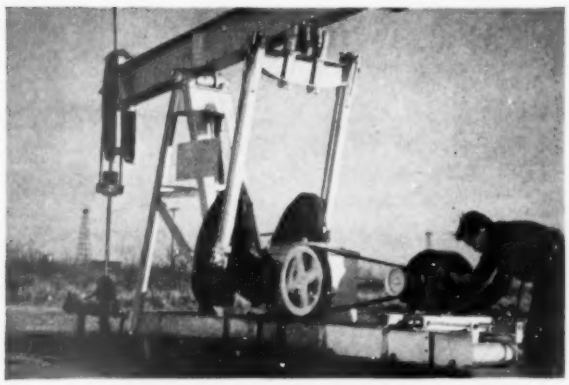
Drilling, waterflooding pumping...the efficiency of all three may depend on the sheave you choose!

Only Worthington's exclusive QD design meets every oil field requirement

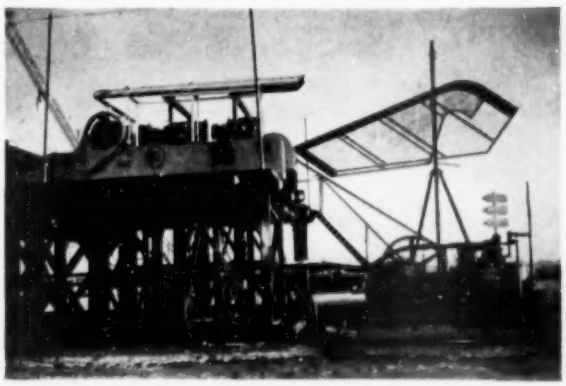
Whether it's easy maintenance, speed in assembly, or just smooth operation you're looking for, you'll get it with Worthington's QD Sheaves.

Their unique two-piece construction makes them easy to get on, easy to get off. Yet the heavy-duty taper cone friction grip hugs the shaft tight against even the heaviest shock loads.

That's why it will pay you to standardize on Worthington QD's for every oil field job. Write Worthington Corporation, Oil City, Pennsylvania.



INDIVIDUALLY DESIGNED FOR THE LOAD it has to carry, the QD sheave on this pumping job will probably outlast the equipment with which it is used. Worthington first built the famous QD to the specifications of oil production men. It's now accepted as *standard* for all kinds of duty.



THE EXTRA GRIPPING ABILITY of the QD sheave is especially important on drilling rigs like this. Its tapered cone friction grip withstands heavy shock loads without slipping. Servicing rigs like this is easier, too, because the QD can be mounted and dismounted faster.

MV.3.7

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BUY THESE WORTHINGTON STANDARD PRODUCTS FROM YOUR LOCAL DISTRIBUTOR

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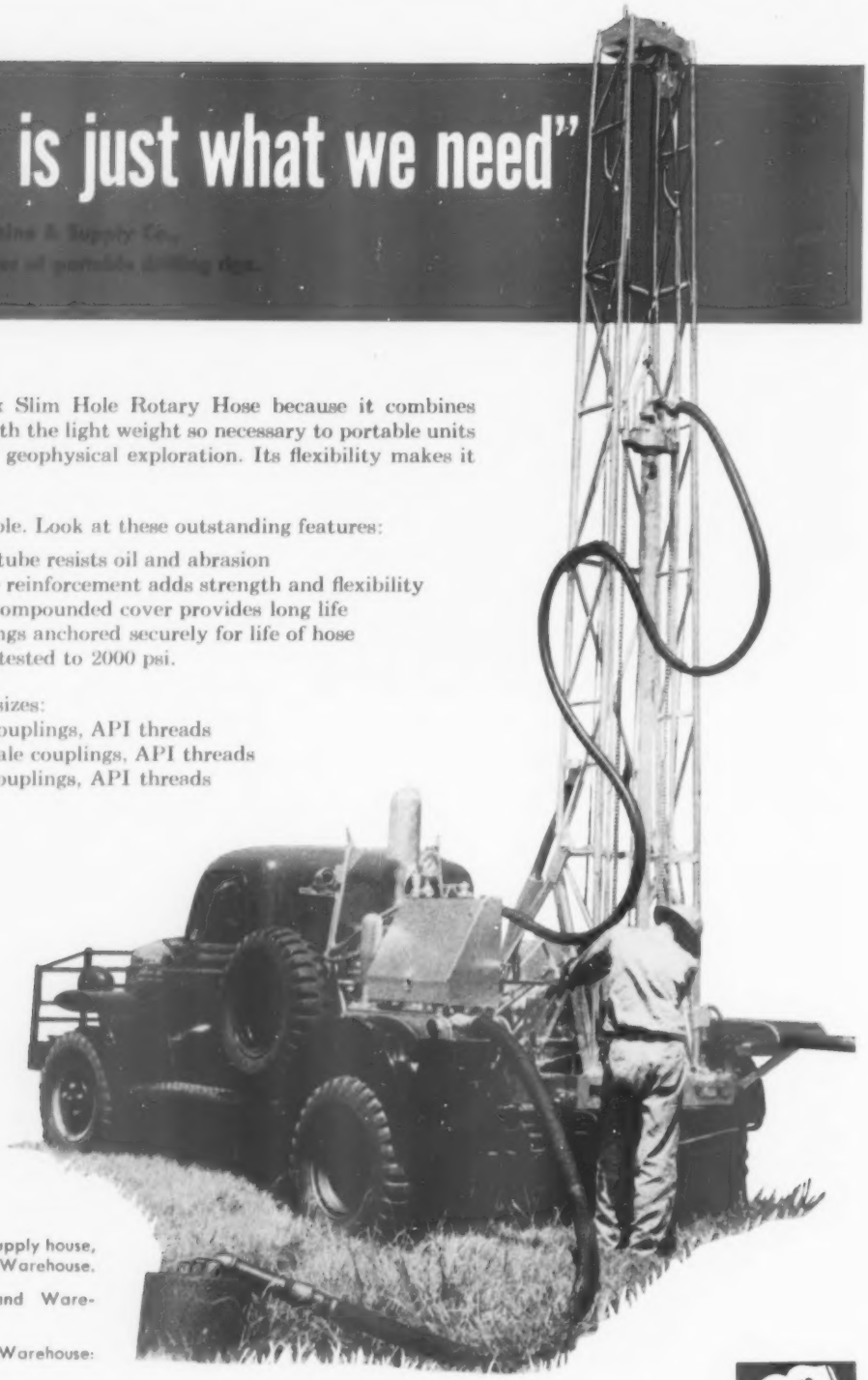
says Mayhew Machine & Supply Co., leading manufacturer of portable drilling rigs.

"We chose Trioflex Slim Hole Rotary Hose because it combines unusual strength with the light weight so necessary to portable units for work overs and geophysical exploration. Its flexibility makes it easy to handle."

Trioflex is dependable. Look at these outstanding features:

- Synthetic rubber tube resists oil and abrasion
- Braided steel wire reinforcement adds strength and flexibility
- Tough, specially compounded cover provides long life
- Pressed-on couplings anchored securely for life of hose
- Every length pre-tested to 2000 psi.

Furnished in these sizes:
2"—with 2" male couplings, API threads
2½"—with 2½" male couplings, API threads
3"—with 3" male couplings, API threads



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- ★ Minimize hazards of volatile or corrosive liquid handling

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B. Instruction Manual . . . provides installation, operation and maintenance instructions for Type U seal. Bulletin No. 52-10100.

C. General Bulletin . . . illustrates and describes three basic BJ types of BJ Mechanical Seals. Bulletin No. 52-10000.

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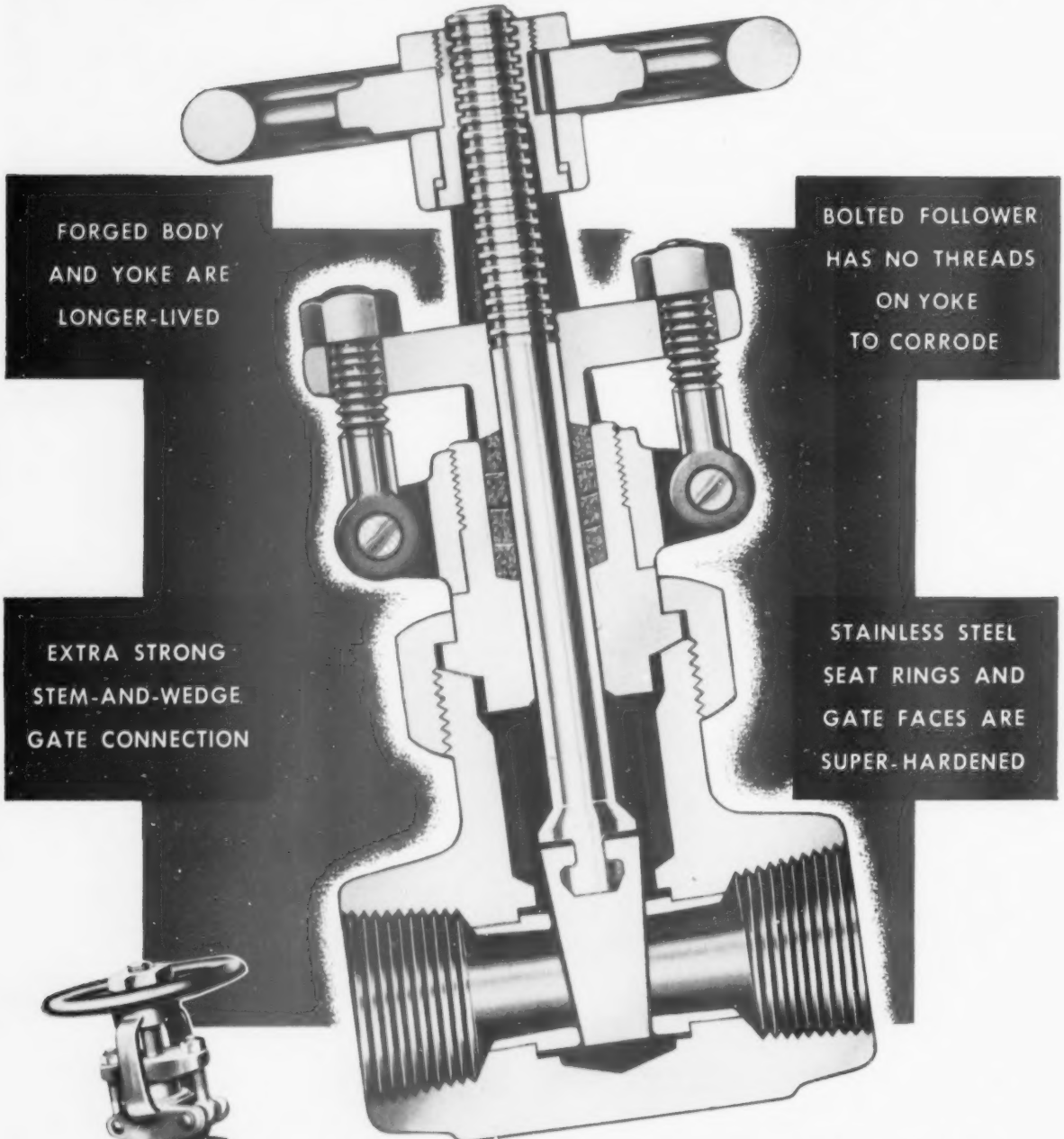
FORGED BODY AND YOKE ARE LONGER-LIVED
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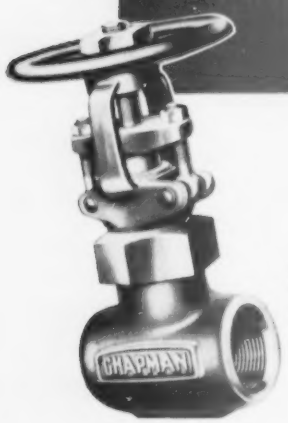
STAINLESS STEEL SEAT RINGS AND GATE FACES ARE SUPER-HARDENED



These hyper-husky, small forged carbon or alloy steel gate valves come in sizes from ¼″ to 2″ inclusive . . . with choice of rising stem with yoke (shown), or with inside screw . . . and with choice of bonnet joints either gasketed or metal-to-metal. Pressure range: 2,000 lb. at 100°F. — 380 lb. at 1,000°F . . . if any higher, specify List 990. Send for Catalog 10.

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LOW COST...
COMPACT...
TROUBLE-FREE...

PENBERTHY
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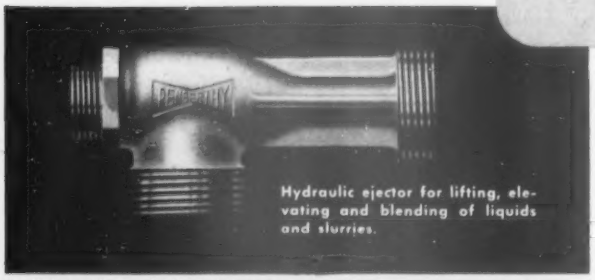
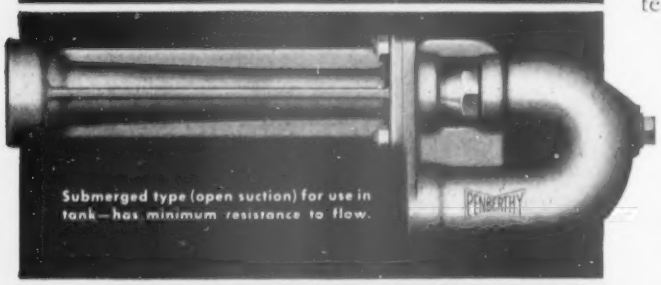


Hydraulic ejector for lifting, elevating and blending of liquids and slurries.

Steam or air operated ejector for a wide range of operating conditions.



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They Say—

U. S. Shouldn't Push Oil Question

"President Eisenhower was right to respond quickly to the call for economic and financial aid from Premier Zahedi and the Shah.

"The first necessity is aid to tide over the present crisis. Then will come the problem of restoring revenues to the point of self sufficiency, which means getting the oil industry going again. Since Iranian oil is not needed in present circumstances, and will, indeed, upset world markets temporarily, Premier Zahedi will not be rushed in this regard. Washington is doing the right thing in extending aid without bringing up the oil problem at the present time."

From an editorial in the New York Times.

Tidelands Law May Set Precedent

"U. S. Attorney General Brownell, in predicting that the outer Continental Shelf land act will become a principle of international law, has said openly what numerous lay observers of the whole tidelands controversy long have suspected, because it makes the only sense possible.

"Since, in asserting ownership over these vast submerged lands belting the nation's seacoast outward from state boundaries, we shall have to recognize similar national ownership elsewhere, it is obvious that the new principle will make necessary complex redeterminations of national interests and eventually a whole series of new treaties.

"The new principle . . . must raise numbers of collateral questions, such as fishing rights, navigation, and aviation. In the last analysis, however, the national domain must devolve upon the capacity to defend it, and it is in this respect that the American assertion becomes significant for the world."

Editorial in the Fort Worth Star-Telegram.

Industry Now Has 'Third Market'

"An area of opportunity, largely closed in this country for nearly 3 decades, has opened up again. It is the area of the 'third market.'

"The 'third market' is neither a 'buyer's market' nor a 'seller's market,' both of which are distress symptoms that arise when supply and demand are out of kilter. The 'third market' occurs when both goods and buying power are ample, and it has sparked the

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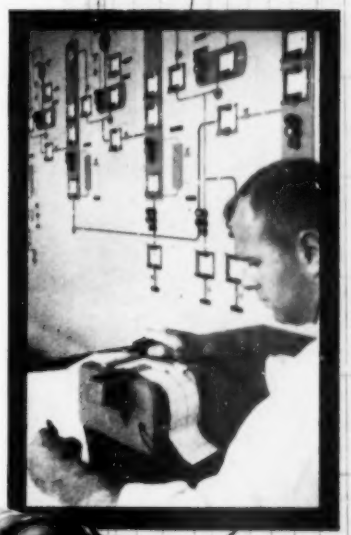
FLOW CHART TOTALIZING OF COST ACCOUNTING DATA AT THE STANDARD OIL COMPANY, EL SEGUNDO, CALIF.



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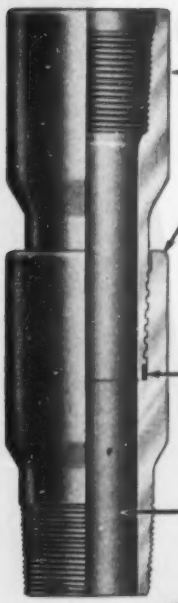
SAME O. D. AS TUBING COUPLING
LEFT-HAND SQUARE THREADS RELEASE EASILY AND POSITIVELY
OIL-RESISTANT THREAD SEAL
"FULL-BORE" SAME I. D. AS TUBING

You need never worry about freeing your tubing from packers and other devices that sometimes freeze in the hole after prolonged periods of use—not if you've taken the precaution to install a Baker Safety Joint strategically in your tubing string.

BAKER SAFETY JOINT

A few turns to the right unscrews the Baker Safety Joint, freeing your tubing quickly and easily. And you just don't worry about the Baker Safety Joint ever freezing or sticking. It is especially designed to unscrew easily even after long periods of sub-surface exposure.

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"Young people getting into industry today are getting a lucky break. Whether they are plant or office workers, technicians or scientists or salesmen, they will gain experience and firm up their philosophy during an era when energy, application, and know-how will pay dividends.

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S. B. Irelan, president of Cities Service Oil Co., in the company's employe magazine, The Empire.

CALENDAR

SEPTEMBER

22-25 Corrosion short course, Texas A. & M. College, College Station, Tex.

24-25 Western Petroleum Refiners Association, regional meeting, Henning Hotel, Casper, Wyo.

27-30 American Society of Mechanical Engineers, annual conference, petroleum division, Rice Hotel, Houston.

Sept. 27-Oct. 2 American Society for Testing Materials, Committee D-2 on petroleum products and lubricants, Shoreham Hotel, Washington, D. C.

28-29 Independent Natural Gas Association of America, Shamrock Hotel, Houston.

28-30 American Society of Mechanical Engineers, Petroleum Division, annual conference, Rice Hotel, Houston.

Sept. 30-Oct. 2. American Association of Petroleum Geologists, Mid-Continent regional meeting, Masonic Building, Wichita.

Sept. 30-Oct. 2 National Association of Corrosion Engineers, Permian Basin section, biannual field tour, Lincoln Hotel, Odessa, Tex.

OCTOBER

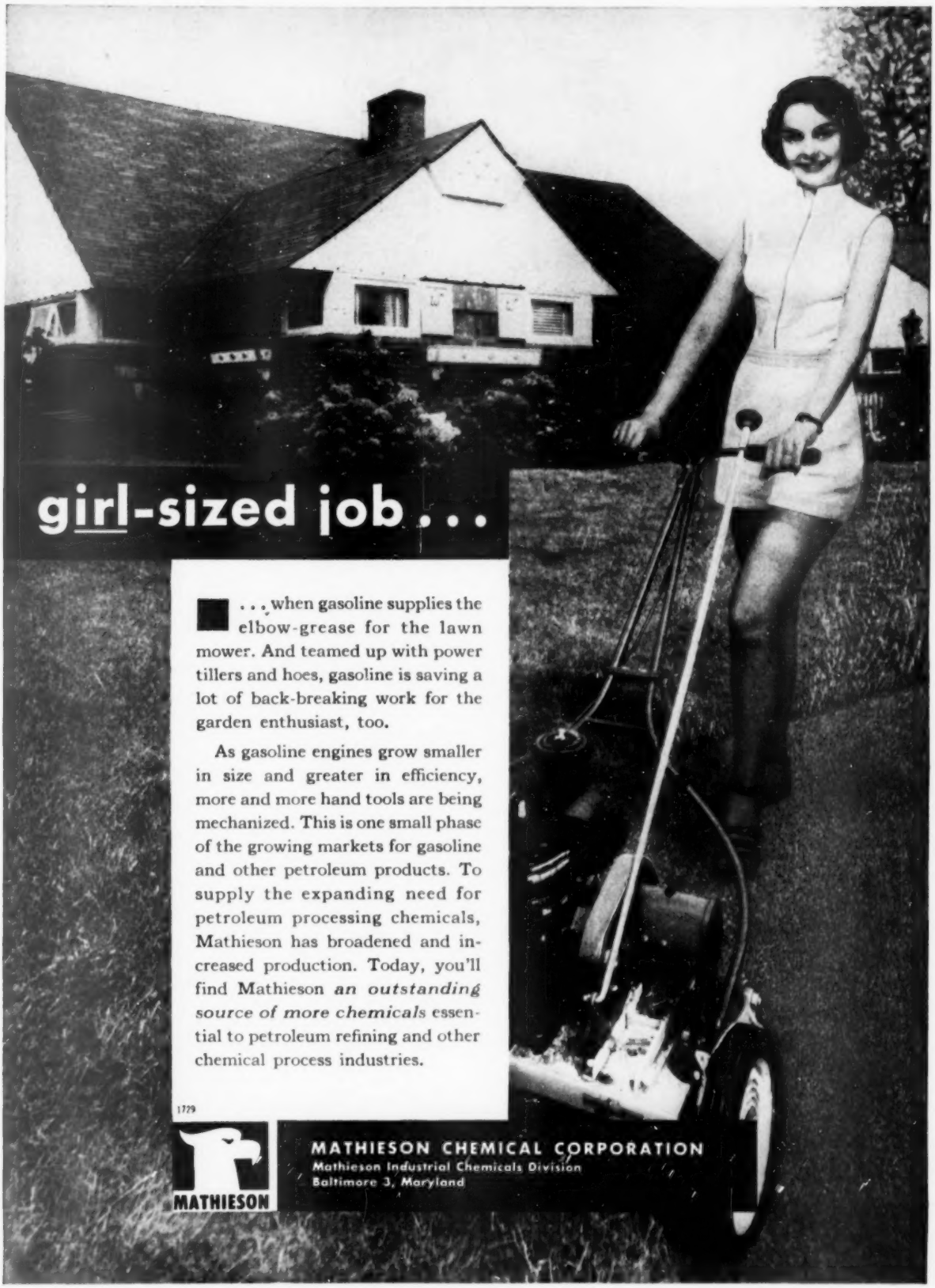
1- 2 Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, annual meeting, Roosevelt Hotel, New Orleans.

4- 6 American Association of Oilwell Drilling Contractors, thirteenth annual meeting, Cosmopolitan Hotel, Denver.

5- 7 Petroleum Electric Power Association, silver anniversary meeting, Muehlbach Hotel, Kansas City.

6- 7 Texas Mid-Continent Oil and Gas Association Rice Hotel, Houston.

7- 9 National Association of Corrosion En-



girl-sized job . . .

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gineers, south central region, Mayo Hotel, Tulsa.

8- 9 California Natural Gasoline Association, annual fall meeting, Ambassador Hotel, Los Angeles.

11-17 Oil Progress Week.

12-16 Short course on cathodic protection, University of Illinois, Urbana.

16-18 New Mexico Geological Society, fourth annual field conference, El Paso, Tex.

19-21 American Institute of Mining and Metallurgical Engineers, petroleum branch, fall meeting, Dallas.

19-20 Independent Petroleum Association of America, annual meeting, Texas Hotel, Fort Worth.

19-23 National Safety Congress, annual meeting, Hotels Conrad Hilton, Congress, Harrison, and Sheraton, Chicago.

21-23 Gulf Coast Association of Geological Societies, third annual convention, Captain Shreve Hotel, Shreveport.

22 American Institute of Chemical Engineers, New York section, symposium, Hotel New Yorker, New York.

22-23 Western Petroleum Refiners Association, regional meeting, Garrett Hotel, El Dorado, Ark.

23 Natural Gasoline Association of America, regional meeting, Blackstone Hotel, Tyler, Tex.

26-28 National Lubricating Grease Institute, Edgewater Beach Hotel, Chicago.

26-29 American Gas Association, annual conference, Kiel Auditorium, St. Louis.

27 Institute of Gas Technology, annual meeting, Chase Hotel, St. Louis.

27 Association of Consulting Chemists and Chemical Engineers, Inc., annual meeting, Hotel Belmont Plaza, New York City.

28-30 Seventeenth Technical Conference on Petroleum Production, Mineral Industries Building, Pennsylvania State College, State College, Pa.

29-31 Rocky Mountain Oil and Gas Association, annual convention, Cosmopolitan Hotel, Denver.

NOVEMBER

3- 4 Society of Automotive Engineers, national diesel-engine meeting, Conrad Hilton Hotel, Chicago.

5- 6 Society of Automotive Engineers, national fuels and lubricants meeting, Conrad Hilton Hotel, Chicago.

5- 6 American Association of Petroleum Geologists, Pacific section annual meeting, Hotel Biltmore, Los Angeles.

9-11 Geological Society of America, annual meeting, Royal York Hotel, Toronto, Ont.

9-12 American Petroleum Institute, annual meeting, Conrad Hilton Hotel and Palmer House, Chicago.

12-13 Society of Exploration Geophysicists, midwestern meeting, Adolphus Hotel, Dallas.

19-20 National Association of Corrosion Engineers, western region, fall conference, Biltmore Hotel, Los Angeles.

19-20 Annual Instrument Short Course, Los Angeles Harbor Junior College, applied technology division, Wilmington, Calif.

20 Natural Gasoline Association of America, regional meeting, Herring Hotel, Amarillo, Tex.

Nov. 29-
Dec. 2 American Society of Mechanical Engineers, Statler Hotel, New York City.

DECEMBER

1- 4 Corrosion conference, University of Oklahoma, Norman.

13-16 American Institute of Chemical Engineers, annual meeting, Hotel Jefferson, St. Louis.

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As fabricators of heat exchanger tubes, we are vitally interested in the science of metallurgy and the insight which it provides into the nature and behavior of metals. But we are equally interested in the practical evidence of actual performance.

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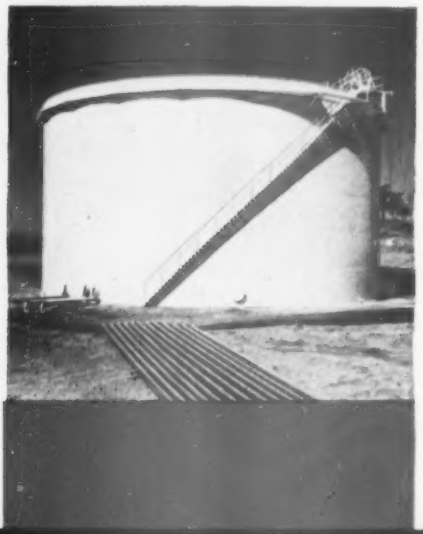
the important factors in **floating roof design**

number 3 of a series



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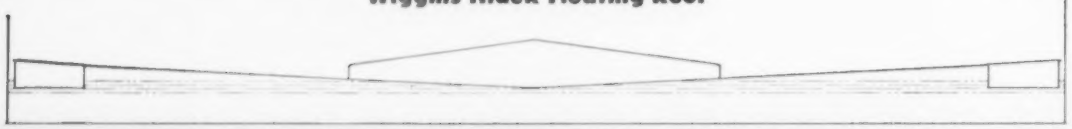
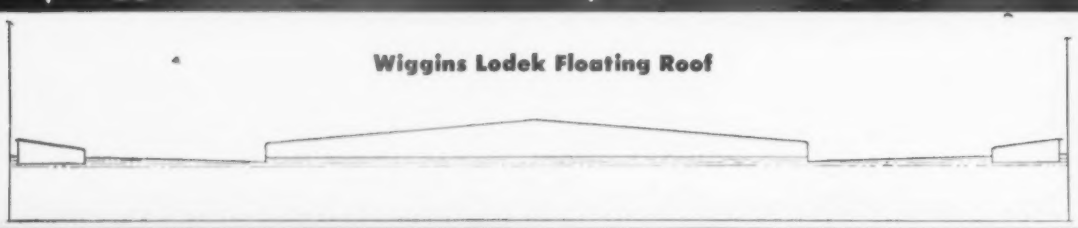
Wiggins Hidek Floating Roof



Only Wiggins floating roofs meet every important design specification

Wiggins Lodek Floating Roof



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JOURNALLY Speaking

Capital Stuff

WILLISTON, N. D.—Warning to the Tulsa Chamber of Commerce! There are at least a dozen rivals up here in the Williston basin of North Dakota and Montana.

Every small town which has an oil well near it—even just one well—has cooked up a slogan proclaiming it to be the Oil Capital—or Oil Capitol, or Oil Center—of the universe, the basin, the state, the area, the county, or something. We didn't see a single Wheat Capital or Cattle Capital, though wheat and cattle have always been the mainstay of this region. It just shows how oil has caught the imagination of the folks up here.

To say that the advent of oil is expected to bring a boom is the understatement of the year. People seem to think that a big city is bound to spring up close to every field. One town held a big christening ceremony when a rank wildcat was spudded in. In another place a wildcat had not yet reached possible pay depths when the operator was visited by a committee of local citizens inquiring how much housing should be provided for the refinery workers.

In one town the county's first wildcat was an indicated success but before it was actually completed the stores all displayed license plates advertising the place as the Oil Capital of the region and the town staged a huge barbecue at which the state's governor and other officials made speeches. One cross-roads hamlet ambitiously erected the "Black Gold Hotel" when a wildcat was spudded nearby; the well was dry, and so is the wheat-field dust that now almost obscures the sign.

The natives here have a very possessive attitude toward the oil industry. They swarm over every drilling rig and ask a zillion questions. They expect oil men to give them tours and lectures, appear on civic luncheon programs, and even bring in new oil wells for every party of visitors. In Mandan, where a refinery is being built, the local residents were highly resentful of the fact that a fence is being built around the property, apparently in the belief that the company is being snooty.

Furthermore, they seem to think that their towns are about to be invaded by hundreds of millionaries and that space will soon be at a premium in the Williston basin, for real-estate prices jump up every time a new well is spudded.

All this has imposed some difficult public-relations problems for the oil operators, many of whom have never before worked in an area where oil was so foreign and so fascinating. They are trying to be accepted in the communities as good neighbors and good fellows, and they patiently explain the intricacies of the industry over and over again. And many a geologist and engineer who never before made a public address has dutifully sweat blood appearing before a school class or ladies' society for the good of the cause.

The land and right-of-way men have to be unusually diplomatic and patient with many of the skeptical farmers in this region. One tells the story of how, after hours of explaining and cajoling, he almost induced an old farmer to sign a right-of-way easement when the deal was queered by a voice from the kitchen: "Don't sign it, Pa. Last time you signed something we got an encyclopedia."

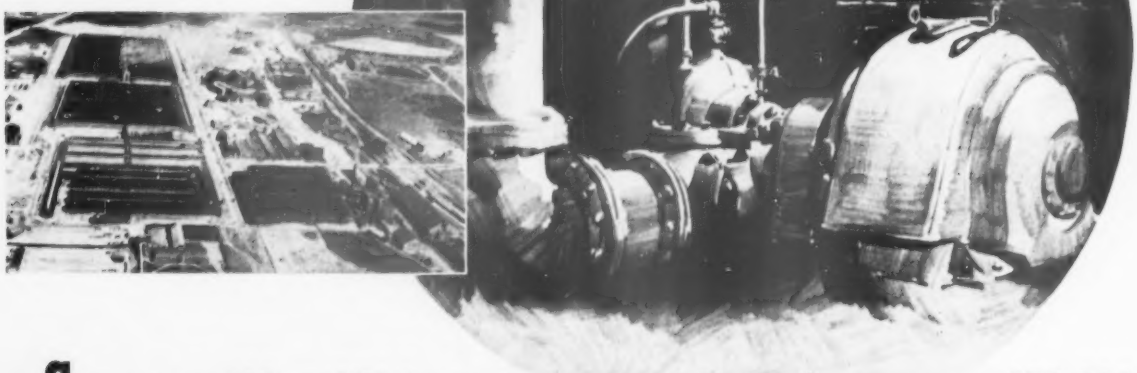
The breezy and informal ways of the transplanted Texans particularly confounded the stolid farm folk for a while, but by now they have been accepted as typical along with the other amazing aspects of the industry. Oil is even transforming the diet of the region. Because of pressure of popular demand, chili now appears frequently on many restaurant menus.

Not universally, however. We have it from an eyewitness that early one blistering August morning a Texas driller perched on a stool in a lunch room and ordered a bowl of chili. "I'm sorry," said the waitress, "we don't have any chili today, but we have beef stew." The Texan looked at her with utmost disgust and blurted out: "Who the Sam Hill ever heard of eating beef stew for breakfast?"

—*Henry D. Ralph.*

DOW CORNING
SILICONES

give motors more muscles



Seventeen 100 to 250 hp motors uprated by 50%; save over $50,000

Largest aluminum producing plant in the world, the Arvida Works of the Aluminum Company of Canada, Ltd., (Alcan) increased its capacity several times in the past few years to a current high of 2 million pounds of ingot per day. Over a year ago an obstacle to further expansion turned up in the ore plant, where bauxite is mixed with a caustic solution to separate the alumina. Called on to handle larger quantities of caustic solution, the plant was unable to replace their existing pump motors with larger motors. There was simply no room for them.

Alcan maintenance engineers neatly solved that problem by rewinding all 17 of their 100, 125 and 250 hp motors with Class H insulation made with Dow Corning silicones. Total power output was increased by more than 50%. The cost of rewinding with Class H materials was $50,000 less than the list price of the equivalent capacity in new motors. And that doesn't include the far greater expense of installing larger pedestals, changing all the fittings, and rearranging the pump lines to accommodate larger motors. Furthermore, downtime was held to a minimum during the changeover.

Rewound with Class H insulation these motors have carried a 50% overload for over a year in spite of frequent spraying with caustic solution. And that's typical of the performance of Class H motors, regardless of size. They can carry heavy sustained overloads; operate with greater power efficiency where periodic overloads are involved; give 10 or more times the life of Class B motors under comparable service conditions. That's why alert management, maintenance and production men now specify Class H insulation for hard-working motors, generators and transformers.

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Why should a pipe line stop at the border?

CANADIAN gas is seeking a market in the United States. American gas is seeking a market in Canada. This poses some problems which ought to be met and solved on the basis of practical horse sense.

The existence of an international boundary stretching across this continent should not interfere with the development of this natural resource in the most economic manner, nor should it prevent gas from reaching its logical markets.

On the eastern end of the boundary, the U. S. Federal Power Commission has authorized the export of natural gas to Canada, but Canadian officials have not yet approved its import. On the western end of the boundary Canadian authorities have approved export of gas to the United States but our FPC has not approved its import.

ONE reason for this is that consumers fear that they will be on the "tail end" of the transmission lines and that the producing country might cut off their supply in case of a domestic shortage or for any other reason or no reason at all. There is some justification for this fear, but it could easily be eliminated.

Why not have a treaty saying that once permission has been given to supply gas across the border, foreign customers will be treated exactly like domestic customers on the same line? Then if some future contingency should require rationing or curtailment of service, the regulatory authorities of the producing country would be bound to prorate the supply without regard to the international boundary.

The same principle could well be applied to electricity moving across the border in either direction, and perhaps also to water supplies. And a similar treaty should be made with Mexico, too. Crude oil and liquid petroleum products should not become entangled in this subject because they are not public utilities, they can shift from one market to another more easily, and questions of tariff are involved.

NATURAL gas is no good to anyone unless it has a pipeline outlet, and the closer the market is to the wells the better it is for both producers and consumers. It makes no economic sense to have unused producing capacity and gasless cities, or to build costly, circuitous pipe lines, because of an international border between the kind of neighbors we are on this continent.

A treaty such as that here proposed would aid the rational development of the petroleum industry of both countries concerned and would foster the economic growth of communities on both sides of the border. It would hurt nobody and help everybody.

Competition for the sale of gas on this continent would then be based on economics rather than on artificial factors of politics or nationalism.

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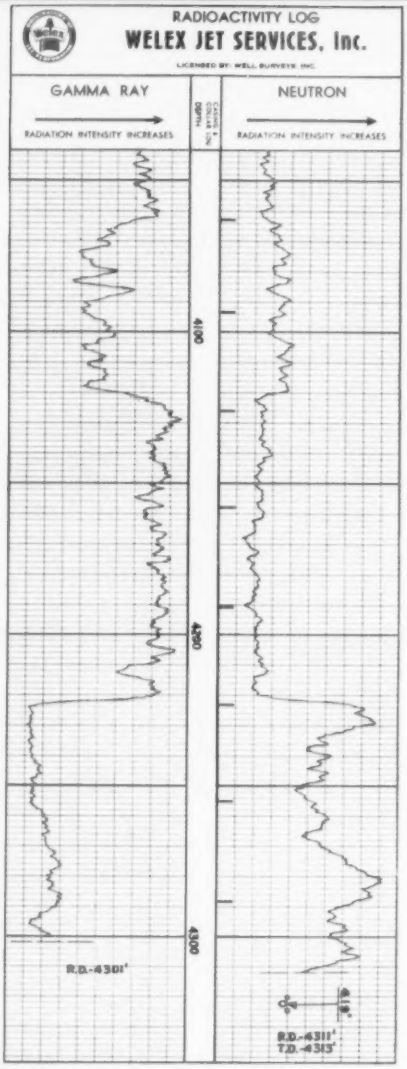

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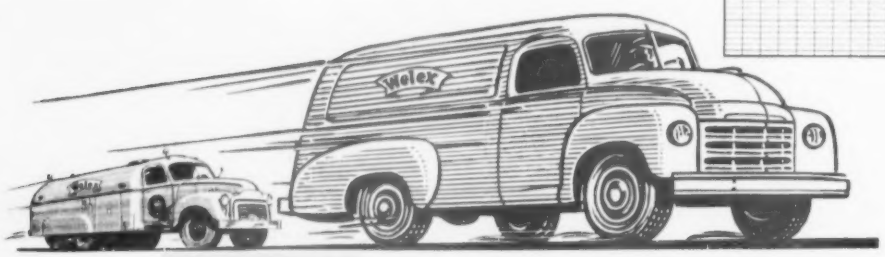

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THIS WEEK

A DRILLING FLURRY has bridged the gap between San Miguelito and Ventura Avenue fields settling once and for all any question about whether or not the two were separate California fields. The well in the foreground is on a Continental Oil Co. San Miguelito lease. The one across the dry wash and those on the mountain are Shell Oil Co. wells in Ventura Avenue. After Continental completed 601 Grubb to extend Ventura Avenue's D-5 and D-6 sand (Pliocene) production into the San Miguelito field last April, a drilling flurry started on the boundary of the two. Continental now has five rigs and Shell has eight at work within a half-mile radius—probably the greatest concentration of rigs in any field today. Total number of rigs at work in both fields is 30. Fifteen are on Shell wells, and 22 of the 30 fall within a circle with a 4-mile radius.

INTERNATIONAL.— Extensive wildcatting in eastern Venezuela is expanding the Greater Oficina area of Anzoategui State . . . ¶Three Latin American explorations set. . . . Glenn McCarthy to drill in Bolivia in November. . . . Peruvian Pacific Petroleum Co., wholly owned subsidiary of Cities Service Co., plans Peru exploration. . . . Union Oil Co. to conduct search in Costa Rica. . . . ¶Japanese Appellate Court upholds lower court's decision permitting Iranian oil imports to continue. . . . ¶Khanaquin Oil Co., Ltd., begins exploratory work in eastern Iraq. . . .

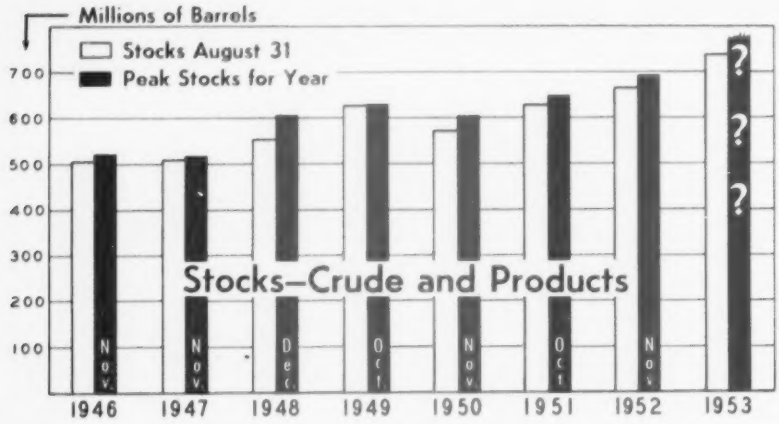
ACTIVITY.—Production of crude and lease condensate averaged 6,481,375 bbl. daily for week ended September 12, down 22,775 bbl. daily. . . . ¶Well completions for the week were up 65 wells to 996. . . . Wildcat completions increase 19 wells to 217. . . . ¶Rotary rigs operating in the United States decreased 61 rigs in week ended September 14 to 2,571, the lowest level since May. . . .

TRENDS.—Refinery runs averaged above 7,200,000 bbl. daily for each of the past 3 weeks. . . . Refiners stored 46 per cent of the distillates produced in the week ended September 12. . . . There has been no net decrease in gasoline stocks in the past 7 weeks and only 1,000,000 bbl. in the past 10 weeks. . . .

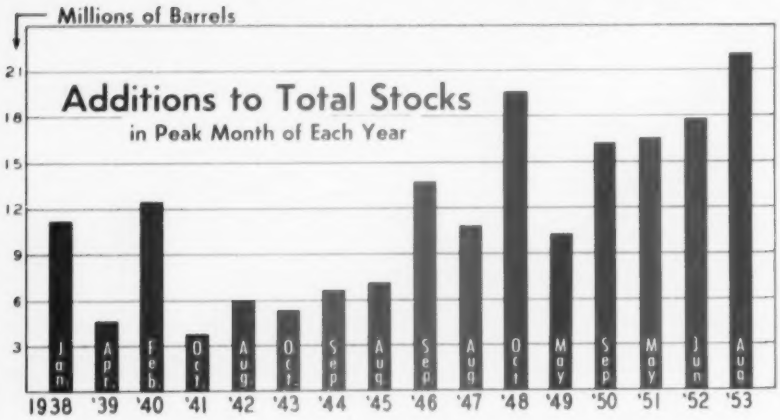
TIDELANDS.—Operators in the Texas Gulf Coast area will be able to obtain both state and federal permits for geophysical exploration of offshore lands from the Texas Land Commission office. . . . Plan is result of agreement of Department of Interior and Texas. . . . ¶A second sale of gulf leases is planned by Texas. . . . Operators are asked to nominate areas for the sale before officials determine the number of leases to be offered. . . . ¶Stanolind files the first of an expected deluge of suits involving offshore leases. . . . Seeks return of leases dropped after Supreme Court decision giving the United States paramount rights to the tidelands. . . .

PIPE LINES.—Williston basin operators disclose they are considering plans to build 1,300-mile crude line from eastern Montana to Chicago. . . . ¶Dedication ceremonies mark readiness of the Edmonton, Alta., terminal of the 711-mile Trans Mountain crude line to Vancouver. . . . Only 12 miles of pipe yet to be laid. . . . ¶Badger Pipe Line Co. announces plans to construct 215-mile products system from East Chicago, Ind., to Madison, Wis. . . .

PRODUCTION.—Crude producer threatened with loss of recent hard-won price increase unless flow of crude can be substantially reduced for next few months. . . . Primary stocks of crude and products at end of August were at all-time peak, and reduction in runs to stills are not sufficient to lower them to safe working level. . . . ¶Operators' deadlock over two opposing plans for unitizing Alberta's big Redwater field may lead provincial government to slash allowable in interest of conservation. . . . ¶Texas Railroad Commission whacks 4 days off the allowable 19 producing days for September for Kelly-Snyder field in West Texas due to "physical waste." . . . Move believed to be intended as spur to operators to agree on plan for water flooding big field. . . .



Stocks Hit All-Time High



And Buildup Continues . . .

. . . High level of activity warns industry of possible price breaks ahead if runs aren't reduced and crude output cut

John C. Casper

LOWER product prices and even softer crude markets are ahead unless the oil industry can restrict the flow of oil for the next few months or until the normal winter increase in demand lowers the level of oil in the storage tanks of this country.

Behind this pessimistic outlook are these factors: Crude and product stocks are at record levels; runs to stills have been unusually high, reaching an all-time record for August; and in spite of the fact that the big gasoline-consuming season until recently was in full swing, there has been no net reduction in gasoline stocks in the past 7 weeks.

Total primary stocks of crude and products at the end of August amounted to an estimated 732,000,000 bbl. for an all-time record. The amount of the excess is shown by a comparison with past inventory peaks. The first chart shows end-of-August inventory levels for postwar years as well as the highest month-end inventory reported for each year.

Stocks at the end of August last year had climbed to a record high despite the loss caused by the refinery strike in May. Note that inventories continued to increase through November. Stocks this year are higher and will continue to climb.

Total inventories at the end of August were about 67,000,000 bbl. greater than a year earlier and about 43,000,000 bbl. above the 1952 peak, reached in November. Other comparisons with August stocks of previous years show increases of 110,000,000 bbl. over 1951 and 163,000,000 bbl. over 1950.

Runs set record . . . Inventories represent the balance between supply and demand, and in recent years inventories have climbed during the summer months.

But, the oil industry of this country ran more crude and products to storage this August than in any other month in its history. The previous record month was October 1948 when the industry's determination to meet the ever-expanding postwar demand resulted in over production and a sharp drop in product prices.

The overflowing tanks at the end of summer resulted from excess production and not from subnormal demands. Total demand for the first half of the year was 6.5 per cent greater than in 1952, and current figures indicate that total demand for the July-August period was up about 5 or 6 per cent.

The small chart shows stock changes for crude and major products in the first 8 months of this year compared with normal changes based on averages for the years 1948-51. The portions of the curve above the zero line indicate additions to storage, and points below the line represent withdrawals.

The smaller-than-normal additions to storage in June this year were due to the time lag between the crude price increase and higher product prices. Consumers as well as secondary suppliers filled their tanks in the last half of June.

The very large increase in primary stocks in July indicates that some suppliers assumed that the big demand in June was a good basis for estimating summer requirements and increased production accordingly.

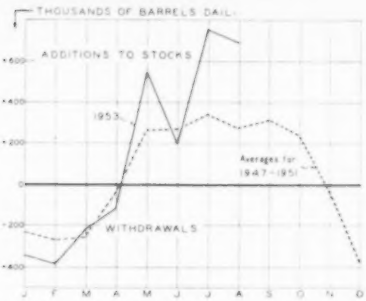
The end result has been an oversupply of oil at a time when storage space is at a premium.

Another important factor in the problem is the fact that an oversupply tends to decrease product sales at a time when movement out of primary storage is needed most.

Secondary suppliers and consumers cut back even on normal purchases hoping for lower prices on distress sales by a primary supplier who does not have storage space for current production.

Cuts in runs are small . . . Reductions

Stock - Change Pattern



in refinery runs reported by refiners from a check of a high percentage of total capacity in most of the important refining areas are too small to have any decided effect on the recent rate of additions to storage.

A Journal survey of the West Coast indicates that none of the major companies have reduced crude runs to stills or plan cuts for the immediate future.

Very little reduction in the Rocky Mountain area has been reported. Carter Oil Co. has cut runs by about 4,000 bbl. daily, and there have been rumors of a few other small reductions.

Other companies reporting reductions in many cases include cuts that have been made over a period of time.

... **Gulf Oil Corp.** reported in late August that runs at Port Arthur had been cut 25,000 bbl. daily since the middle of July and that no further reductions were contemplated.

... **Esso Standard Oil Co.** announced that runs for the first 8 months of the year had been slightly under the same period in 1952. Spokesman for the company had no comment on further cuts which may be planned.

... **Sinclair Refining Co.** reported the same situation that was announced at the end of August, a reduction of 20,000 bbl. daily. Unconfirmed non-company reports indicate that the cut was on the East Coast.

... **Tide Water Associated Oil Co.** announced a cut of 12,000 bbl. daily at the Bayonne plant starting with the second week of September.

... **Cities Service Oil Co.** reports a gradual reduction in runs during the late summer, amounting to a cut of about 20,000 bbl. daily from peak runs earlier this year.

... **Atlantic Refining Co.** has cut runs since the first of August and is now running about 6,000 bbl. daily less than had been originally scheduled for this season. The cut is split between Gulf Coast and East Coast plants.

... **Phillips Petroleum Co.** reported that runs had been reduced about 8,000 bbl. daily early in September.

In the Mid-Continent area rumored and reported cuts amount to about 20,000 bbl. daily. In some cases company spokesmen did not want to be quoted.

Other companies, with about 3,000,000 bbl. daily capacity, either would not comment on the possibility of a reduction in runs or reported that no cuts were anticipated at present.

Most of the reported reductions in runs were either in late August or early September and should have been reflected in the A.P.I. report of refinery runs for week ended September 12. Runs for that week averaged 7,216,000 bbl. daily for one of the 5 weeks on record with runs above 7,200,000 bbl. daily.

Crude outlook . . . Many refiners, particularly on the Gulf Coast, are of the opinion that production and imports of crude should be cut back sharply to reduce some of the pressure on the refiner from the flow of contracted crude into his plant.

Texas allowables were reduced for September. Total average calendar day allowable for September 5 was 2,981,000 bbl. daily compared with 3,142,000 bbl. daily for August 29.

The reduction of 111,000 bbl. daily in purchasers' nominations for October indicates that users of Texas crude either plan to run less to refineries or want to reduce stocks of Texas crude by about 3,500,000 bbl. next month.

Stocks of Texas crude totaled 132,000,000 bbl. on September 5 compared with 126,000,000 bbl. last year.

Purchasers of Oklahoma crude advised the Oklahoma Corporation Commission early this month that they were having to take about 55,000 bbl. daily in excess of their requirements for Oklahoma crude. The commission issued an emergency order which provides for a reduction of 20 per cent for allocated fields and a cut of 15 bbl. per day per well in the maximum for the marginal class.

The allowable in Oklahoma was reduced from 539,905 bbl. daily in March to 519,260 bbl. daily in April, and has been held at that level since that time. However, the cut in allowable was not accompanied by a corresponding cut in production. Current production is estimated at about 556,000 bbl. daily.

In Louisiana, John B. Hussey, Commissioner of Conservation, announced the state's 700,000-bbl. allowable would be cut about 17,000 bbl. in October.

Reduction imminent . . . Everyone agrees that the current supply of crude and products should be cut, and the recent trend in inventories is toward a condition by the end of the month that will force some reductions. Refiners can no longer wait for the "other fellow" to cut runs.

The crude producer, confronted with the possibility of the loss of his recently received and long-needed price increase, will not only agree to but will be asking for a reduction in allowables.

Antitrust Suit Delayed

NEW YORK.—The Department of Justice's civil antitrust suit against five major American oil companies ran into a further delay last week because of the illness of a federal judge.

A hearing in the case in federal District Court in New York was postponed indefnitely. The hearing had been scheduled on a government motion to require companies to produce additional documents.

Federal District Judge Vincent L. Leibell, to whom the case was originally assigned when it was transferred from Washington, is in ill health and not in a position to undertake a suit which may be several years before the court. The presiding judge will assign another jurist to hear the case.

Palmer Properties Bought

WICHITA, Kans.—All of the producing properties and some of the non-producing properties formerly owned by Palmer Oil Corp., Wichita, have been purchased by San Diego Corp., Wasatch Corp., and Airfleets, Inc. The properties, in Oklahoma, Kansas, Texas, and Louisiana, were valued at $4,500,000.

The properties were purchased from Wren Oil Co., and Oil Equities, Inc., which earlier had bought from Tom Palmer all outstanding stock of Palmer Oil Corp.

Atlas Corp. is a stockholder in San Diego, Wasatch, and Airfleets, which were represented in the transaction by Dale R. Snow, Tulsa.

Industry Briefs

HOUSTON.—A new wage clause offered by Hughes Tool Co. has been accepted by members of the Independent Metal Workers Union Locals 1 and 2, ending a 3-day strike at the big oil-tool manufacturing concern here. The 3,800 production workers will receive an average increase of 10½ cents per hour.

BEAUMONT.—The Bethlehem shipyard here has delivered a new $700,000 offshore drilling barge to Blackie Drilling Co., Franklin, La. Construction began 3 months ago.

Redwater Unit Snags

Operators in Canada's largest producing field unable to agree on allocation formula for unit operation

EDMONTON, Alta.—An impasse on two plans for unitizing the 800,000,000-bbl. Redwater field promises to result in the government cutting back allowables in the field for conservation purposes.

There are 926 producing wells in the field, 35 miles northeast of Edmonton, and present allowable is 97 bbl. daily for most wells.

The reservoir has no gas cap and production is by water drive. It is feared that at present production rates, wells will be flooded out before maximum recovery can be made.

The unitization formula proposed by Keplinger and Wanenmacher of Tulsa is being opposed by a group of the field's operators. The Keplinger plan calls for sharing the first 50,000,000 bbl. of production on a straight well basis. The remainder would be shared 25 per cent on ability of the wells to produce and 75 per cent on thickness of zone.

Imperial Oil, Ltd., the largest operator in the field, opposes the plan and offers an alternate. A group including Royalite Oil Co., Ltd., Triad Oil Co., Ltd., Dome Exploration, Ltd., Texaco Exploration Co. and Albercan Oil Co., Ltd., joined Imperial in the opposition.

Imperial plan . . . The alternate plan offered by Imperial puts emphasis on porosity rather than thickness of the pay zone. Under this plan, the first 100,000,000 bbl. would be allocated according to the ratio of the adjusted production ability factor to the total production ability of the field.

Stating that it represented 66.9 per cent of the total wells in the Redwater area and 67.8 per cent of the production, the Imperial group suggested that operators be allocated their share of the total amount of oil in place under each well after the 100,000,000 bbl. had been produced.

Opposing Imperial group were: Amerada Petroleum Corp., Home and Federated (Oilwell Operators), Bay Petroleum Corp., Bishop Oil Co., British American Oil Co., Ltd., Canadian Gulf Oil Co., C. L. McMahon, Scurry Oils, Ltd., Pacific Petroleums, Ltd., Seaboard Oil Co. (Del.), New Superior Oils of Canada, Ltd., Western Leaseholds, Ltd., Calvan Consolidated Oil & Gas Co., Ltd., and A. G. Bailey Co., Ltd.-Selburn Oil Co., Ltd.

Figures questioned . . . This group questioned how Imperial and its backers arrived at the amount of oil in place. Many contended that while Imperial in the first instance said the division should be on recoverable oil in place, the formula actually called for oil in place, which was a different matter. The argument in general was that correct porosity below most of the wells is unknown and that even for oil in place the porosity factor is vital.

The amount of water in place with the oil, which would make a difference to the volume of oil recoverable, was also debated. Imperial used a figure of 15 per cent connate water, but some operators said connate water varied from zero to 100 per cent.

The British American representative declared that the Imperial figures on porosity were inaccurate. B.A. said it has the only section at Redwater where every foot penetrated had been cored. Actual analysis, claimed B.A., has shown porosity of 5.62 per cent, while Imperial's figure was 4.65 per cent.

Permit Granted

Trans-Canada gets license to ship Alberta gas East

EDMONTON, Alta.—In a desperate effort to prevent the populous Toronto - Montreal - Ottawa triangle from slipping through its fingers as a big market for Alberta gas, the Alberta Petroleum and Natural Gas Conservation Board last week hastily granted Trans-Canada Pipe Lines, Ltd., the first license to export gas to eastern Canada.

The board's decision came much sooner than expected. It apparently was made in hopes that Consumers Gas Co., Toronto, may yet be thwarted in its effort to import about 22,000,000,000 cu. ft. of Texas gas annually for the Toronto area through Tennessee Gas Transmission Co. and Niagara Gas Transmission Co. lines.

Stumbling block . . . Only stumbling block to such import is the possibility that the Canadian federal government may forbide it by stretching the provisions of the Export and Import Permits Act of 1947 or by passing legislation specifically designed to prevent gas import.

If this is the intention of the federal government—and that body has followed a policy for some time now favoring Canadian gas for Canadian markets—the Alberta conservation board's move would be added ammunition. Consumers Gas, however, is reported confident that the federal government cannot find fair grounds for blocking the Texas deal. The latter firm has a 20-year guaranteed supply of gas in Texas and could obtain this gas much earlier (late 1954) than via the all-Canadian project, which would take considerably more than 2 years longer to build.

The Trans-Canada line would have to be laid through roughly 1,800 miles of rugged country from Alberta, through Manitoba, and around the hump of Lake Superior to Ontario and Quebec. Estimated cost of the project is a staggering $300,000,000.

Price argued . . . Consumers expects to market gas in Toronto at a firm 53.17 cents per M.c.f. at the start. It is believed that Trans-Canada could not meet this price without benefit of a government subsidy. Critics of the Consumers deal argue that the price of the Texas gas may go as high as 69 cents during the third year of operation. Consumers officials, however, say that this is false, since the price to be paid for the gas is higher than the going price for gas in the producing area.

Whatever action the Canadian Government takes is expected to come soon, since a Consumers application to bring its line across the Niagara River from an interconnection with Tennessee at Buffalo is imminent.

Gas-Line Subsidy?

Alberta premier suggests it for export to the East

EDMONTON, Alta.—A subsidy has been suggested here by Premier Ernest Manning as a possible solution to the export of Alberta natural gas to eastern Canada over an all-Canadian line.

The premier, who also is minister of mines and minerals, said he is not suggesting the federal government should subsidize the actual operation of an all-Canadian pipe line, but that the people as a whole should subsidize initial construction costs.

"If it is in the national interest," Manning said, "that an all-Canadian line be built—even though such a line is uneconomical — then such a line should be made economical by subsidization by the people as a whole."

Manning added that he was not suggesting that an all-Canadian line is uneconomical, but only that the dominion government should subsidize such a line if it is.

Ready for export . . . The premier said Alberta has a substantial surplus over and above its own requirements. He said the Alberta Petroleum and Natural Gas Conservation Board is trying to find out just how much that surplus amounts to.

"As far as the government is concerned, it is our intention to approve export of any or all of that surplus," he said.

He pointed out it is important that gas arrive in eastern Canada at a competitive price; otherwise, there is no incentive for natural-gas exploration and development in Alberta.

He pointed out that a company desiring to export gas to the United States must acquire five authorizations: (1) a charter from the Canadian government; (2) an Alberta government permit on the authorization of the Alberta conservation board; (3) approval of the federal Board of Transport Commissioners if interprovincial boundaries are to be crossed; (4) an export permit from the federal department of trade and commerce, and (5), before the gas enters the United States, the approval of the U. S. Federal Power Commission.

Terminal Dedicated

Edmonton station ready for Trans Mountain oil

EDMONTON, Alta.—Premier Manning officiated at the dedication ceremonies here which marked the readiness of the Edmonton terminal of the 711-mile Trans Mountain pipe line to Vancouver.

The Edmonton terminal covers a 160-acre tract and consists of eight 150,000-bbl. and four 80,000-bbl. cone roof steel tanks. Five feeder lines connect the terminal to the various major oil producing areas in the Edmonton district. These are Leduc, Woodbend, Armena-Camrose, Wizard Lake, Bonnie Glen, Stettler, Big Valley, Redwater and Excelsior.

The Edmonton terminal is connected with other points along the line by a telephone circuit approximately paralleling the pipe line and connecting about 25 locations; a teletype service connecting about 7 locations and company-owned dual-frequency radio facilities, including 9 fixed stations and 25 mobile stations.

The 24-in. pipe line will have an initial capacity of 120,000 bbl. daily, with pump stations at East Edmonton, Edson, and Kamloops. This will be increased to 150,000 bbl. daily by the end of the year, when a fourth station at Black Pool, B. C., is completed.

Platform guests at the dedication ceremonies included: S. D. Bechtel, chairman of the board of Trans Mountain; H. H. Anderson, vice president and general manager; S. D. Blair, vice president and chairman of the construction committee; W. M. V. Ash, president, Shell Oil Co. of Canada, Ltd.; R. D. Baker, president, Standard Oil Co. of British Columbia, Ltd.; J. W. Hamilton, director, Imperial Oil, Ltd.; J. G. Spratt, president, Anglo Canadian Oil Co., Ltd.; W. J. Wilkins, Gulf Oil Corp.

Crude Line Nears Completion

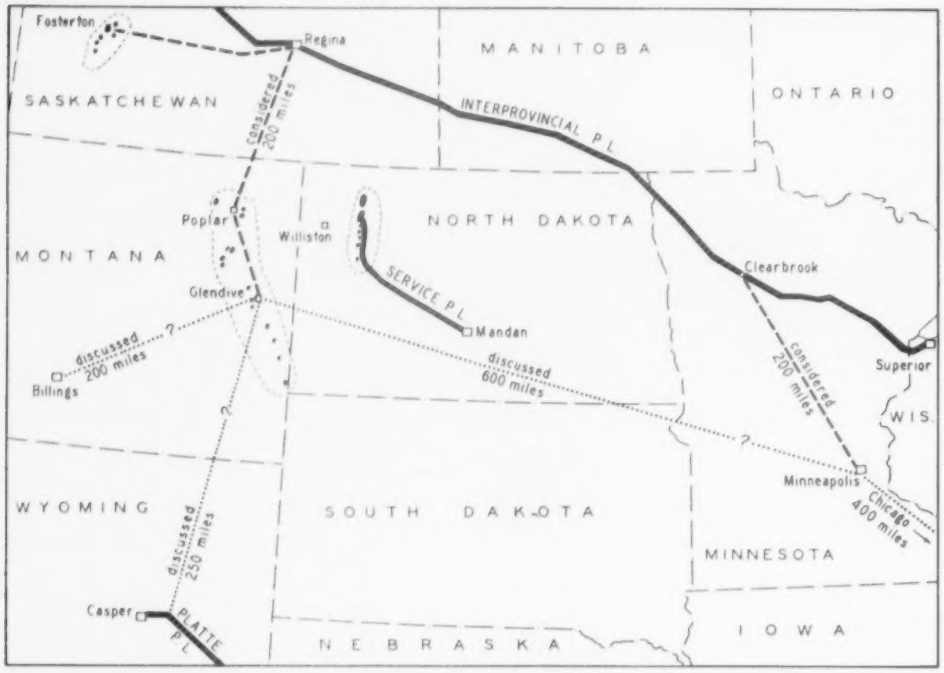
VANCOUVER.—Only 12 miles of pipe remained to be laid late last week on the Trans Mountain crude-oil line from Edmonton to the Puget Sound.

Pressure testing had been completed on the first 575 miles of the line, except for one 6-mile section. H. H. Anderson, vice president of Trans Mountain Oil Pipeline Co., said the Edmonton and Kamloops pump stations have operated satisfactorily on tests and during line filling. The Edson station, he said, is scheduled for completion September 26 and the Black Pool Station December 1.

Ceremonies formally opening the huge new crude line are scheduled to be held in Vancouver October 15, although the line is expected to go into actual operation about 2 weeks earlier.

For Wildcatting in Alaska . . .

Two strings of drill pipe, one 3½-in. and one 4½-in., are included in this shipment of oil-exploration equipment now en route to Alaska for the joint exploration program of Phillips Petroleum Co. and Kerr-McGee Oil Industries, Inc. The loaded L.S.T. is being towed to Icy Bay, eastern end of the million-acre strip on which the two companies will conduct their search. The ship also carries three carloads of cement, eight carloads of drilling mud, casing, logging equipment and other supplies and equipment needed for the exploratory program. In the foreground of the picture at right are lube oils and antifreeze.



PIPE-LINE PROJECTS running in all directions are being discussed to provide an outlet for the fast-developing producing capacity of the Montana part of the Williston basin. A group of big operators is now giving serious consideration to the longest haul of all—eastward to the Twin Cities and Chicago.

Montana Crude: Where Will It Go?

Williston basin producers are toying with bold project involving 1,300-mile pipe line to Chicago refinery area

Henry D. Ralph

BILLINGS, Mont.—A crude-oil pipe line from eastern Montana to Chicago is under active consideration by a group of oil producers with big interests in the Williston basin.

The project is still in the preliminary planning stage and if built would not be completed before late 1955 at the earliest, but the word that the plan has strong backing has already given a big fillip to oil interest in this area where crude-producing capacity is being built up rapidly with no market outlet in sight.

For months the Montana air has been full of rumors of pipe-line projects and of arguments over whether the logical route would be north, south, east, or west.

Now five companies or groups of companies have pooled their thinking and have decided that the basin's destiny lies to the east. They are drawing plans for a bold project which leans heavily on a big gamble that the Williston basin will rapidly become a huge producing region.

Line is talked . . . They are talking about a 24-in. crude line—with a capacity far above the volume of crude now in sight — running some 1,300 miles via Minneapolis and St. Paul to the Chicago refining and pipe-line center. The main trunk line probably would originate somewhere near Glendive, Mont., more or less in the geographic center of the string of fields recently opened along the trend of the Baker-Glendive anticline.

The spearhead in the discussions is Murphy Corp., which has the largest production in the Montana portion of the Williston basin at present. Murphy is operator of the East Poplar unit, which also includes the H. L. Hunt interests, Carter Oil Co., and Phillips Petroleum Co. However, Carter and Phillips are not actively backing the project at present.

Others participating in the planning are:

. . . Shell Oil Co., which has several producing or producible fields along the Baker-Glendive trend.

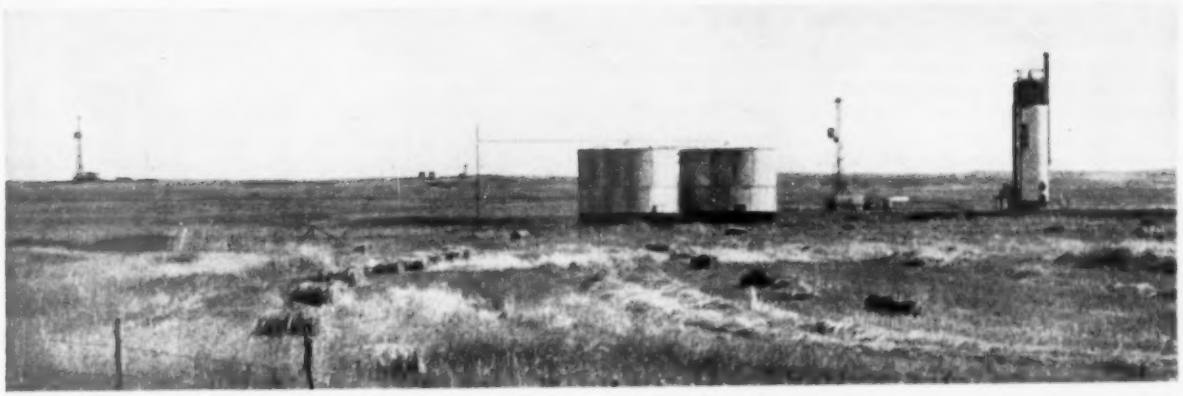
. . . The Texas Co., which has production in Glendive field and other interests in the area.

. . . Socony-Vacuum Oil Co., Inc., which is conducting an active exploration program in Montana, North Dakota, and Saskatchewan.

. . . The so-called Tide Water Group working jointly in Saskatchewan and composed of Ohio Oil Co., Atlantic Refining Co., and Columbia Carbon Co., with Tide Water Associated Oil Co. as the operator.

The five participants have held several committee meetings on the project and it is reported that planning has progressed smoothly so far, although there are many hurdles ahead and there is still no certainty that the line will be built. Several other companies with interests in the Williston basin have had observers at some of the sessions, but at present only the five named are actively participating in the planning.

Gamble on future . . . There is not nearly enough crude oil available in eastern Montana—or the entire Williston basin, for that matter—to support a 24-in. crude line at present, so the project, if built, will be a gamble on the future. On the other hand, considerable production in the area is shut in and exploration is in danger of slowing down for want of a crude outlet, so the prospect of available pipeline capacity is counted on to stimu-



BIGGEST PRODUCING FIELD in eastern Montana is East Poplar, at the northern end of the Baker-Glendive trend in the Williston basin. It is currently producing around 2,400 bbl. per day, all moving by rail, and would be the chief initial supply for any pipe line from the area. There are now 22 producing wells in the 16,000 proven acres of this field, and the two rigs shown in this view are steadily employed drilling additional development wells.

late drilling throughout the region to be served.

No definite route for the line has been agreed on as yet. It is roughly 600 airline miles to Minneapolis from Glendive, but the producing area of eastern Montana spreads over a distance of more than 150 miles, and the line would have to be located so as to serve the diverse needs of the various participants.

The participants will have to sign deficiency agreements committing themselves to make up allotted portions of the operating cost unless and until sufficient crude becomes available to make the line a financial success.

There are also problems of raising the initial capital, selecting an operator for the line, breaking into the crude-oil market in the Great Lakes area, and many other matters to be ironed out before the project is actually launched.

How the project got to its present stage is an interesting example of forward thinking and cooperative effort in the oil industry.

How it started . . . East Poplar unit is currently producing a little more than 2,000 bbl. per day, most of which is shipped by rail to the Phillips refinery at Spokane, Wash. The high rail freight yields a low netback at the wellhead, but even this market will be lost next year when the Phillips refinery shuts down, as is scheduled on completion of the Yellowstone products pipe line from Billings to Spokane *(The Oil and Gas Journal, August 31, pages 75 and 80).*

As operator of this field, Murphy looked for other possible outlets, and the nearest pipe line is that of Interprovincial Pipe Line Co., which passes through Regina, Sask., some 200 miles to the north. Murphy considered laying a line to Regina and asked Interprovincial to quote a tariff on moving its crude from Regina to Detroit via its United States subsidiary, Lakehead Pipe Line Co., which is now extending its line across Michigan to Sarnia, Ont. Murphy also asked the United States Bureau of Customs about procedure for moving United States crude through Canada in bond.

At this point Murphy asked Shell, its closest neighbor and the next-largest producer in eastern Montana, to participate, and Shell officials expressed considerable interest in a pipe line to Regina.

It was then discovered that Socony-Vacuum was considering a pipe line from the Clearbrook, Minn., pump station of Lakehead pipe line to the Minneapolis-St. Paul area where there are two refineries with a capacity of 40,000 bbl. per day and not served by any crude lines. Socony-Vacuum's Canadian subsidiary, Socony-Vacuum Exploration Co., already has announced plans for a pipe line to Regina from the group of fields in the Fosterton area of Saskatchewan.

Somebody suggested that Montana crude might find a market in Minneapolis via Interprovincial and the proposed Socony line without moving all the way to Detroit. Socony-Vacuum was interested, but then it was realized that the two projects would involve laying more than 400 miles of pipe, which was two-thirds the distance from Glendive to Minneapolis.

Logical development . . . So the next logical development was to consider an "all-American" route directly from Montana to Minneapolis-St. Paul, make it big enough for future crude production, and locate it where it will best serve the needs of the sponsoring companies. A line the size now being considered could carry more crude than could be used by refineries now in Minnesota or likely to be constructed there, so thought is being given to extending it another 400 miles or so to Chicago where it could connect with a network of crude lines running east.

While the projected line probably would go across the southern part of North Dakota, no consideration is being given at present to the possibility of moving North Dakota crude through it, nor are North Dakota interests taking part in the discussions.

More than 95 per cent of North Dakota's production is on the Nesson anticline, where Amerada Petroleum Corp. is by far the largest producer. Crude from the Beaver Lodge and Tioga fields is all being purchased by Stanolind Oil Purchasing Co., and most of this is currently being railed to the refinery of Standard Oil Co. (Ind.), at Whiting, Ind.

Beaver Lodge line . . . By next summer Service Pipe Line Co. will have completed a crude line from Beaver Lodge-Tioga to Mandan, N. D., where Standard is building a refinery.

The northwestern third of this line is 12 in. in diameter and runs close to a series of recently discovered fields on the Nesson anticline. The remainder is 16 in. in diameter. Service officials say they had nothing in particular in mind when they designed the line in this fashion, but it would seem obvious that they anticipated that some time in the future there would be crude reserves developed in eastern Montana and southwestern North Dakota which would seek an outlet through the line.

The line could handle as much as 100,000 bbl. per day but the Mandan refinery is being designed for only 30,000 bbl. per day, which suggests that somebody in the Indiana Standard group anticipated eventual extension beyond Mandan. Stanolind Oil & Gas Co. is doing active exploration work

on a large area touched by this crude line, but has no actual production there as yet. Amerada and the Indiana Standard group have not participated in the discussions of the Montana - Chicago pipe line.

Oil operators went into the Williston basin with full knowledge that it might be a long time before there was a pipe-line outlet for any crude developed, and it has been only in the past 6 or 8 months that sufficient reserves have been established in eastern Montana to make it possible to even think about pipe lines.

All summer the chief topic of discussion up here was where a pipe line should go, and every direction had its adherents. A hatful of proposals was noised about, but none of them appeared to have backing by substantial interests.

The nearest trunk line is that of Interprovincial in Canada, which operates as a common carrier and through which United States crude could be brought back to this side of the border in the Great Lakes area.

Not much farther to the south a connection could be made to the Platte line, which runs from Wyoming to the refining and pipe-line center of St. Louis and Wood River, and which has some unused capacity.

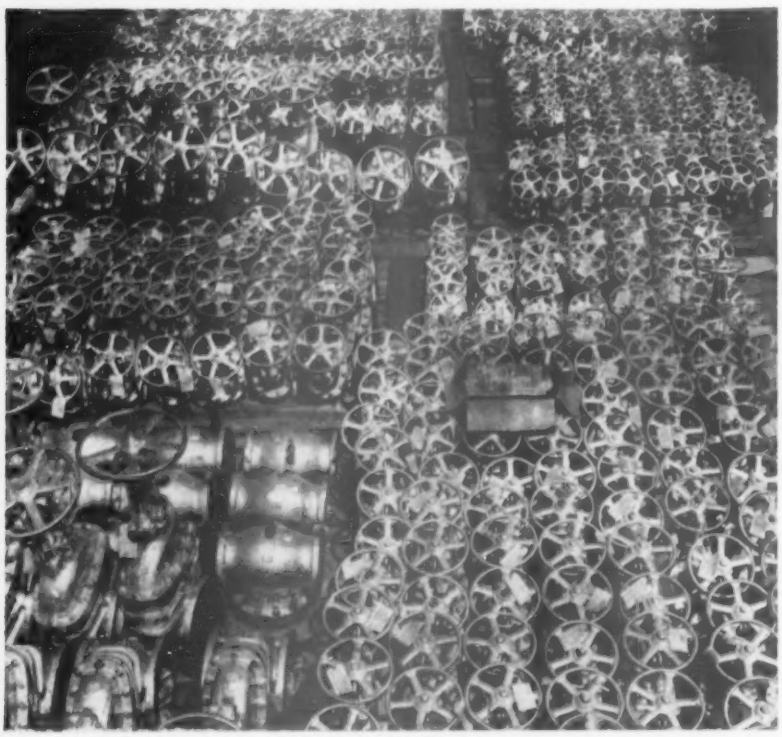
Billings refineries . . . Billings seemed the logical outlet to many producers and promoters. Here and at nearby Laurel are three refineries which will soon have a combined capacity of close to 40,000 bbl. per day. These refineries run primarily on Wyoming crude, and their operators—Carter Oil Co., Continental Oil Co., and Farmers Union Central Exchange—have exhibited no particular enthusiasm for financing a crude line from the east.

For quite a while there was a big body of opinion that the Pacific Coast offered the best future outlet for crude from the Rocky Mountain region, including even the eastern part of the Williston basin. Sentiment for such a long pipe line over many mountain ranges is cooling off with the realization that California's crude shortage has eased and the new Trans Mountain Pipe Line will soon be delivering a big volume of Alberta crude to the Puget Sound area.

The biggest market, of course, is Chicago and the refining areas to the east which are served by the network of pipe lines running near the southern tip of Lake Michigan. But Chicago is some 1,200 miles from Montana, and the Great Lakes area is already well supplied with crude from the Mid-Continent and Southwest—formidable obstacles to the financial attractiveness of such a line.

Standing in the way of all these pipe-line ideas is the fact that at present eastern Montana is not producing enough crude to support any pipe line in any direction.

But the Williston basin is big, and in spite of all its dry holes and semi-commercial discoveries, the operators here have faith that in time it will have many good producing oil fields and a profitable pipe-line outlet.



Acres of Valves

In storage at Mandan, N. D., awaiting their places in the refinery which is being built by Standard Oil Co. (Ind.), are just a part of the roughly $500,000 worth of valves the plant will require. Valves usually represent about 2½ per cent of the cost of a modern refinery.

Scurry Output Cut

Final arguments heard on huge water-flood project

AUSTIN.—Operators in Kelly-Snyder field of Scurry County read a Texas Railroad Commission order last week and discovered they already had produced virtually all of their allowable for September.

In an unusual development, the commission on September 14 announced that effective at 7 a.m. the following day the field had been cut to 15 producing days because of "physical waste."

The announcement came just before operators presented oral arguments in a commission hearing on a secondary-recovery plan proposed by the Scurry Area Canyon Reef Operators Committee. This plan, contemplating a line-type water flood down the center of the field and gas injection in some areas, has been vigorously opposed by a minority group headed by W. A. Moncrief.

A final decision by the commission, which for several years has encouraged the unitization of the field and development of a repressuring plan, is expected soon, probably within the next 2 weeks.

If the commission should approve the SACROC plan, both gas injection and water flooding could begin in a short time. The gas-injection plant already has been completed. Virtually all equipment is on hand and the contractor has been selected for the water-injection plant, and its operation would be expected within 2 months or so of a go-ahead signal by the commission.

SACROC has estimated that ultimate recovery from the 1,238-well field would be increased by 720,000,000 bbl. under its plan. Moncrief has opposed the SACROC program and advocated adoption of a peripheral flood which he maintains would result in a greater ultimate recovery than the SACROC plan.

SHOOTING AN AREA off the coast of Texas, a Shell Oil Co. geophysical boat is shown working within the state's 10½-mile jurisdiction. Any operator may now obtain permits to carry on geophysical work in the Continental Shelf off Texas by applying to the Texas Land Commissioners's office in Austin under an agreement between the state and the Department of Interior. The simplified procedure allows oprators to obtain permits for work in both state and federal areas from one source.

Offshore Permit Plan

Both state, federal permits for geophysical operations in Gulf will be issued by Texas land commission office

AUSTIN.—Texas will accept a proposal by the Interior Department that the state land commissioners' office be responsible for the issuance of all geophysical permits for offshore work in the government-owned Continental Shelf adjacent to state-owned lands.

The only question in the minds of the commissioners is whether Texas or the U. S. Geological Survey would have the final regulatory authority.

Bascom Giles, commission chairman, has indicated the proposal would be approved when the supervision clause "is clarified to the commissioners' satisfaction."

When this clarification is made, the agreement will be entered in the official Federal Register, and thereby become effective.

Under the proposal, which was submitted to the state on suggestion of Giles that such an agreement would be helpful, all parties concerned would benefit. Among the advantages were:

. . . **Operators** would be able to get all of their geophysical-prospecting permits from a single source—the same office which has been issuing them permits for work closer to shore on state-owned areas. This would simplify the paper work and speed up issuance of permits.

. . . **Texas** would have effective "control" over all geophysical activity in the Gulf of Mexico adjacent to the state. This would hold true whether Texas or the U.S.G.S. was given final authority to enforce rules and regulations, because, by issuing all permits, the state could "keep track" of all geophysical crews working in areas adjacent to state-owned leases. It would not have to "guess" as to who was doing what just over the boundary line. Texas would, as a result, be able to keep a pretty close eye on all activity in the general coastal area.

. . . **The federal Government** would not get involved in the issuance of the permits, leaving the matter entirely up to Texas as to who would be best qualified to work on government-owned Continental Shelf waters.

The matter of final rules enforcement, should it fall to the U.S.G.S., would be more or less routine, as the Government is always aware of who is working where offshore. All companies must get a permit from the U. S. Engineers, before they can install any facilities in navigable waters.

This permit carries its own regulations, and the companies know pretty well what they can and cannot do in navigable waters. The army engineers chart each obstacle placed in the water, and record fully the type of activity going on in given areas.

Clarification necessary . . . The Government's proposal indicated that Texas "inspectors" would enforce regulations on geophysical prospecting in submerged lands of the Continental Shelf beyond the 10½-mile state boundary. But Giles and the other commissioners were doubtful as to whether Texas would have this responsibility or whether it would fall to the U.S.G.S.

"Commissioner Giles wants to make sure there will be no question as to who is to enforce the rules before final approval is given," Dennis Wallace, chief clerk of the land office, declared.

H. J. Duncan, chief of the conservation division of U.S.G.S., said that agreements similar to that offered to Texas could be presented to Louisiana "or any other interested states." The Texas proposal contains a provision making the entire agreement subject to termination on 60 days' notice.

Test Going Deeper

Shell Weeks Island well may be new world record

FRANKLIN, La. — What may become the world's deepest producing well was within 391 ft. of establishing a new record for deep drilling in Louisiana last week and Shell Oil Co. was drilling ahead in shale below 18,270 ft.

The 2 Gonsoulin - Minville State Unit has been drilled almost a thousand feet deeper than any other well in Weeks Island field. Shell already has the world's deepest production in 1 Weeks Gall Unit of the same field. It was completed in March as a gas-condensate well through perforations from 17,039-17,122 ft. in the Miocene.

The existing Louisiana depth record is held by Magnolia Petroleum Co. 1-D Ragley Lumber Co., Allen Parish. This well was abandoned as a dry hole in 1952 at a depth of 18,660 ft.

Cores taken . . . Cores have been recovered in the 2 Gonsoulin-Minville below 17,300 ft., but no results have been announced. The well is already 270 ft. below the original target of 18,000 ft. A 7-in. string of casing was

set to around 17,348 ft., and 4½-in. liner is to be set to bottom, according to present plans.

The deepest test drilled at Weeks Island before the Shell well passed the mark in August, was Humble Oil & Refining Co.'s 1 Hortense Gonsoulin, drilled to 17,403 ft., and completed in an upper section of the lower Miocene.

Improved drilling techniques enabled Shell crews to drill the 2 Gonsoulin-Minville to a depth of 17,404 ft. in a little more than 90 days. In addition to this feat, more than a thousand feet of hole has been cut below the 17,000-ft. mark in a little over 30 days.

While the company would not confirm them, reports have been circulated that commercial shows were encountered in the deep well. However, as long as the hole remains in good shape, the company will drill ahead.

The deepest test ever drilled along the Gulf Coast was George Vasen's 1 fee in Stone County, Mississippi. Now shut down, this test reached a total of 20,450 ft.

Gulf Lease Sale

Operator interest awaited to determine size of sale

AUSTIN.—The General Land Office will offer another group of Gulf of Mexico leases at a sealed-bid sale in Austin December 1, but just how many remains to be determined.

The land commissioners' office said that operators have until September 21 to get in their nominations.

"We have no indication of how the nominations will come in," a spokesman said. "It will depend, of course, on the amount of interest shown as to how many leases will be put on the sale."

The commissioners' office indicated that the early closing date for nominations should give operators "adequate time" to get their permits and carry on geophysical work before submitting bids. No deadline as yet has been announced by the land office on when all bids must be received.

It is the land commission's plan not to put too many offshore leases on the block at one time, Dennis Wallace, chief clerk, told The Oil and Gas Journal. He said that the commissioners felt that to issue more leases than they knew could be developed adequately within a 5-year period would be detrimental to proper development.

"We don't want to put, say, 300 or 400-acre blocks up in big lots, but would rather stagger the amount so that development of these offshore areas will follow along accordingly," Wallace said.

Second sale . . . The sale on December 1 will be the second held by the state involving Gulf of Mexico leases in 7 years. At the first sale, held on September 1 in Austin, Stanolind Oil & Gas Co. was the successful bidder on the four tracts offered *(The Oil and Gas Journal, September 7, 1953, page 70).*

Stanolind has no definite plans to drill in the area, off Jefferson County, at present.

First Offshore Case

Stanolind sues Louisiana to reinstate six leases

BATON ROUGE.—The first suit of an expected deluge of court actions involving offshore leases has been filed in the Nineteenth District Court here by Stanolind Oil & Gas Co.

The company is seeking a declaratory judgment on its claim to six leases totaling 30,000 acres of undeveloped submerged lands in the Gulf of Mexico roughly 3 to 11 miles off Terrebonne Parish, Louisiana.

The case will decide whether the leases are still valid, in view of Stanolind's releasing them back to the state on September 15, 1950.

Stanolind acquired the leases September 12, 1946. Originally for a 5-year term, they later were extended another 2 years, making the effective expiration date September 12, 1953. The company contends the term was further extended under the Submerged Lands Act to February 23, 1956. Stanolind paid a total of $447,875 in bonuses and yearly rentals to keep the leases in effect until September 12, 1950. On June 5, 1950, the U. S. Supreme Court handed down its decision holding that the federal Government held paramount rights in the tidelands. Deciding that its rights to the leases were at best nebulous in view of the court ruling, Stanolind failed to meet the rental payment due September 12 and turned them back to the state as required.

Back rentals paid . . . However, when Congress passed the Submerged Lands Act on May 22, 1953, it required the states to recognize leases that were in effect when the Supreme Court ruling was handed down. The act also provided that lease holders must pay all rentals on nonproducing leases and royalties on producing leases accruing from June 5, 1950, to May 22, 1953, within 90 days of the latter date.

Before the 90-day deadline, Stanolind proffered a check to the Louisiana Register of Lands for $358,875 in payment for all rentals on the leases from September 12, 1950, to September 12, 1954. The state refused the check on the grounds that it was not the intention of the Submerged Lands Act to reinstate leases which had been turned back to the state.

The state's refusal to accept the back rentals on the leases also is believed to be based, at least in part, on the acknowledged fact that new leases on the involved lands could be negotiated at terms much more favorable to the state.

WEST COAST

Anticracking Order Sought

LOS ANGELES.—That the general public believes the refining industry is still the major contributor to the Los Angeles smog problem was revealed by a proposal of Pasadena city officials last week.

In a request to be filed with the Air Pollution Control Commission and the county Board of Supervisors, the city asked that all cracking operations be eliminated at refineries in the Los Angeles area.

Unsaturated hydrocarbons contained in cracked gasolines, and released during refining and storage, are being blamed as a principal producer of smog. Reversion to use of only straight-run gasolines will clear the atmosphere, Pasadena's City Manager D. C. McMillan, claims.

Submarine Line Completed

VENTURA, Calif.—Tide Water Associated Oil Co. last week completed the laying of an 18-in. submarine line extending 4,300-ft. into the Pacific Ocean here.

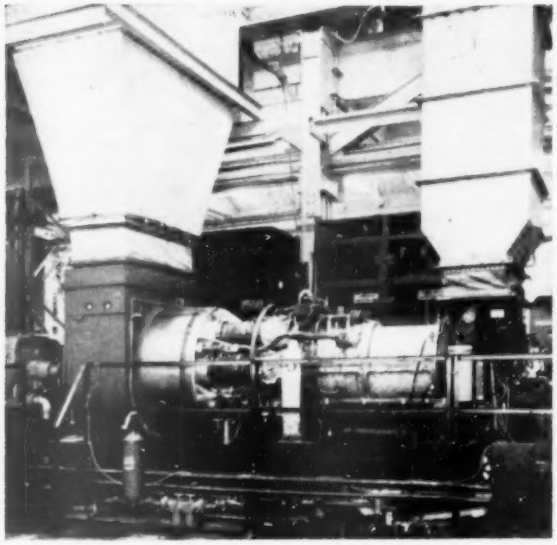
The line, of 10,000-bbl.-per-hour loading capacity, supplements an existing 16-in., 3,300-ft. line. Largest tankers can now be loaded with Ventura Avenue crude since the line terminates in 43-ft. water. It was laid in six sections, each about 725 ft. long.

Leasing Amendment Proposed

LONG BEACH, Calif.—The Long Beach City Council in a charter amendment meeting last week voted that all contracts or leases for development of city oil resources be awarded on the basis of sealed public bids.

Under the existing charter the council is required to let development contracts by public bidding, but leases may be awarded by negotiation. No date was set for voting on the proposed amendment.

Gas Turbine Applied to Petrochemical Plant for First Time



This General Electric gas turbine will be put to work for the first time in the petrochemical industry at one of the major refineries of Esso Standard Oil Co. The 5,700-hp. gas turbine will drive a three-case, 16-stage Ingersoll-Rand centrifugal compressor that compresses hydrocarbon gas to about 285 psig. Turbine speed is controlled throughout the normal operating range of 6,400 r.p.m. by a pneumatic controller adjusting a fuel valve to maintain the desired compressor suction pressure.

NATIONAL AFFAIRS

Parting Shot Fired

FTC commissioner looses final volley at industry

WASHINGTON. — Retiring Federal Trade Commissioner Stephen J. Spingarn (his term expires September 25 and he was not reappointed) unlimbered his biggest guns for one last shot at the oil industry last week.

The "international oil companies," Spingarn asserted, have decided to continue to base world prices on current market prices in the United States despite the greatly altered circumstances of world supply.

"If this decision goes unchallenged, the international oil companies will be provided with a precedent on the basis of which they will be able to drive prices in world markets to higher and higher levels," he asserted.

The 16-page statement recounting the sins of the oil industry was labeled as coming from Spingarn's office rather than from the commission.

Spingarn explained that the industry has as a tool for price control the "quasi-governmental control mechanism in the United States, the private control mechanism in world petroleum trade, and the international basing point system which ties the two mechanisms together."

The result, he said, is a private monopoly and "the alternatives to private monopoly in any area of economic activity are a competitive market or some form of governmental supervision." He could not say which alternative was best in this case but, he declared, "I feel that the time has come for the Government of the United States to face the realities of the situation and to chart a course of action which will make the essential interests of this country and of our allies paramount to private interests."

Control mechanism . . . Spingarn explained that the mechanism for controlling domestic oil production consists of the conservation laws of the producing states, the Connally Hot Oil Act and the Interstate Compact Commission.

This mechanism, he said, "could not operate or exist for long if importers of foreign oil or refined products were to import large quantities of low-cost oil for sale at low prices. The fact that the recent price increases did not affect such competitive action on the part of importers is a tribute to the effectiveness of private controls over the international oil industry and to the common interests of the international oil companies in both the American and the international oil industries."

The private mechanism for controlling the international oil industry is that described in the FTC staff report on the International Petroleum Cartel, the locking together of the interests of the seven international companies, and the basing of world prices on U. S. markets, he said.

"The spread of the recent United States price increases to all world markets clearly demonstrates a fundamental anomaly in the world pricing system for crude oil and refined products," Spingarn asserted. "Prices for foreign oil have been raised at a time when world supply has been tremendously increased by the development of a new low-cost production center, i.e., the Middle East."

War Reserve Urged

Independent refiners want federal capacity support

WASHINGTON. — Government action to build the reserve refinery capacity required for all-out war was urged upon the administration last week by the Independent Refiners Association of America.

In a letter to Interior Secretary Douglas McKay, Elmer Batzell, counsel for the association, challenged the recent determination by the Petroleum Administration for Defense that unused capacity this year is 10.4 per cent and asserted that the real excess is only about half that much when capacity taken out of operation for maintenance and repair is considered.

To have excess capacity readily available for immediate use in the event of war, Batzell asserted:

. . . **There must be** an operating concern which can exercise the management functions required in order that the facilities be used.

. . . **The facilities** themselves must be maintained in operable condition.

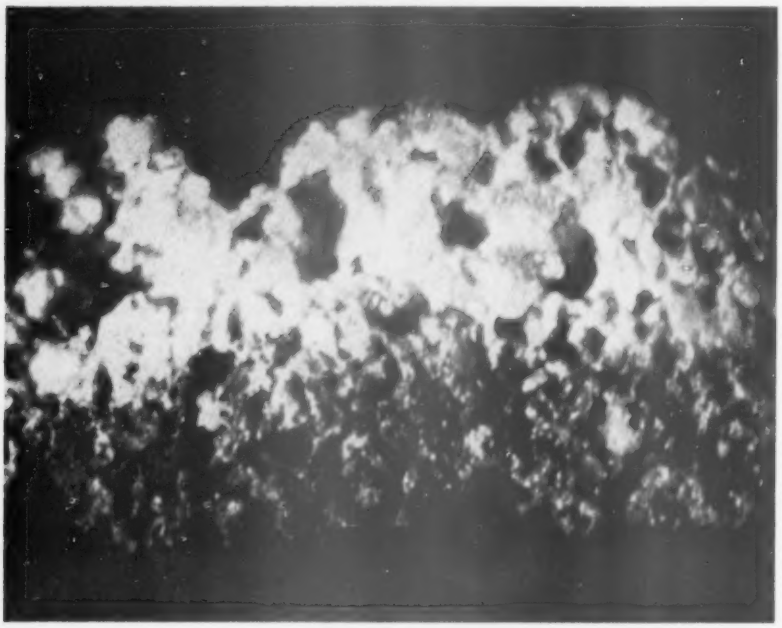
. . . **There must be** an existing and readily available supply of raw materials which can be obtained and utilized in increasing quantities by the facilities.

. . . **There must be** existing channels of movement for the products produced by the facilities which will assure their immediate distribution to points of need.

. . . **There must be** an existing financial arrangement whereby necessary funds are available to cover the operating costs of the facilities plus the raw material costs.

"All of these conditions add up to the fact that whatever the reserve capacity is, it must be associated with a going concern which can sustain the capacity of idleness in times of peace and at the same time have it ready for immediate call in the nation's interest in times of imminent emergency," Batzell explained.

The industry itself cannot develop this surplus capacity, Batzell asserted, because there is an inadequate return to the refiner to meet all of the costs of operation on a restricted basis.



THE CULPRIT is shown in this cross-section of leaded-fuel piston-top deposit, photographed by du Pont, is enlarged 50 times.

Ping Sparks Research

Preignition still roadblock in path of top auto-engine efficiency, but industry works toward problem's solution

This is the second of two articles on preignition by the Journal's refining editor. The first, generally defining preignition and tracing the growth of the problem with the development of new high compression automotive engines, appeared on page 76 of the September 14 issue of the Journal.

George Weber

NEW YORK.—Determining the relative contributions of engine deposits and engine design to the preignition problem may aid researchers greatly in finding a practical means of supressing preignition.

Research indicates pretty strongly that either or both of these factors may hold the key to the problem. Engine deposits are now being explored thoroughly by refiners and fuel additive manufacturers and the automotive industry is taking a new look at engine design with the preignition problem in mind.

It is most difficult to get down to brass tacks on how and why engine deposits cause preignition. In road performance in multicylinder engines, deposits are constantly building up and flaking off the walls of the combustion chambers. Since they refuse to hold still, exact duplication of test conditions is impossible. In order to get consistent results from studies of the effect or particle size, composition position, etc., it is necessary to resort to some arbitrary means of control.

E. I. du Pont de Nemours & Co., Inc., has developed and used the deposit aspiration method to good advantage. This consists of injecting controlled amounts of both natural and synthetic deposits into laboratory engines, and noting their effect on preignition.

They found that 0.1 gram of deposit injected into the combustion chamber would cause preignition under certain operating conditions. In this test preignition was indicated by observing the pressure-time relationship. An electronic counter automatically detected abnormal pressure due to preignition.

First, they found that preignition increased with particle size up to 60-100 mesh, so they standardized on that size range. Previous laboratory findings showed that pure carbon showed a high glow point. When mixed with lead salts, however, the glow point was reduced to 3-400° F. and longer glow duration was encountered.

To find out which lead salt was the worst offender, they mixed different salts with dextrose and injected them into the engine. During comparable runs, pure carbon alone gave one preignition. Lead oxide, lead chloride, lead sulfate and lead phosphate alone gave only two preignitions. But, carbon mixed with these respective lead compounds showed wholly different results. Lead oxide plus carbon gave twenty-one preignitions and lead chloride and lead sulfate with carbon gave eight each. Significantly, lead phosphate with carbon gave only two.

The next step was injection of these deposits into three cars on a road test. The laboratory effects of the lead salts alone and in combination with carbon were satisfactorily borne out. Hence, it may be concluded that lead salts resulting from reactions of tetraethyl lead in gasoline, catalyze the carbon deposits in combustion chambers to cause them to glow at lower temperatures, through longer periods, thus promoting preignition.

Cycling tests . . . Another approach to the study was the testing of various fuel-lubricant combinations with respect to their effect on the amount and composition of deposits and their resulting effect on preignition. These tests employed multicylinder engines with compression ratios of 9:1 and 10:1. The cars were cycled for 130 hours at light duty using the test fuels and lubes, to build up deposits. They were then switched to reference fuels every 2 hours for four acceleration tests to determine the minimum octane at which knock and/or preignition occurred. Amplified rumble was used to indicate preignition in these tests.

Leaded and unleaded catalytic cracked gasoline, isooctane, commercial base stock lubes and synthetic lubes were tested in various combinations. In general they found that with leaded commercial fuel and commercial lube both engines were definitely preignition-limited, requiring excessively high octane reference fuel to suppress preignition rumble. Substituting synthetic lube for commercial lube showed little improvement in preignition.

The use of the cleaner-burning leaded isooctane with commercial lubes reduced preignition appreciably, and further reduction resulted from switching to synthetic lube. Unleaded isooctane used with synthetic lube showed no preignition with the high compression engines. These engine tests con-

firmed earlier tests of the deposition characteristics of the various fuel-lube combinations.

Preignition resistance of fuels . . . In combination with the investigation of deposits, further knowledge is needed concerning the relative tendencies of various fuel components to preignite under operating conditions. Test results to date have proved somewhat confusing.

Du Pont investigators have reported on a number of pure fuel components. They have found that results will vary, depending on the type of test, since the fuel ignition temperature depends on how hot the igniting surface may be.

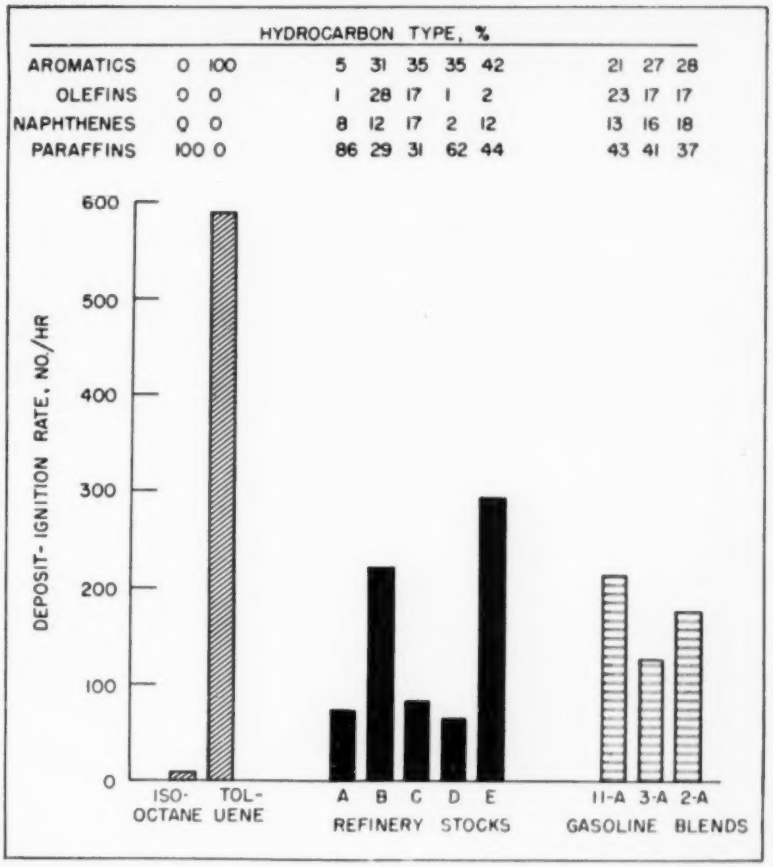
In the deposit aspiration test, where deposits were injected into the combustion chamber, they found that of six fuels tested, cumene and benzene tended to ignite most readily. Isooctane, xylenes, toluene and diisobutylene showed best preignition resistance in that order. These deposits floating free in the fuel-air mixture promote severe hot spot conditions.

Tests using a spark plug as the ignition source showed different ratings for fuels. In these tests presenting moderate hot spot conditions, the order of merit from best to worst was: diisobutylene, cumene, benzene, isooctane, toluene and xylenes.

In an attempt to determine which of the two tests was the more realistic, Du Pont, then conducted road tests. They showed isooctane and diisobutylene as rating the same, with benzene considerably inferior. These conflicting results, Du Pont concludes, make it apparent that the empirical approach of fuel evaluation must be supplemented by a study of the fundamental factors involved.

It should be noted that these ratings are obtained on pure hydrocarbons. It appears that benzene for example which in general shows up poorly when tested in the pure state, gives much improved preignition resistance when blended with other hydrocarbons. This fact, plus the basic disagreement in test results, may alleviate fears of some refiners operating catalytic reformers, that aromatics, particularly benzene have been definitely proven to be bad actors from the standpoint of preignition. It appears likely that in their normal percentages present in commercial gasoline, these aromatic components may not cause as much preignition trouble as was originally believed.

Ethyl Corp. has also tested various fuel components for their tendency to preignite. Employing the deposit ignition counter, they found that the deposit-ignition rates for pure benzene and toluene were far higher than those shown by various naphthenes, olefins and paraffins.



ALTHOUGH PURE FUELS show extreme results in preignition tests, their effect in blended fuels is not yet specifically understood. This is illustrated by these results obtained by Ethyl. "Refinery stocks" and "gasoline blends" end points are approximately 400° F. Fuels contain 3 ml. of TEL per gallon.

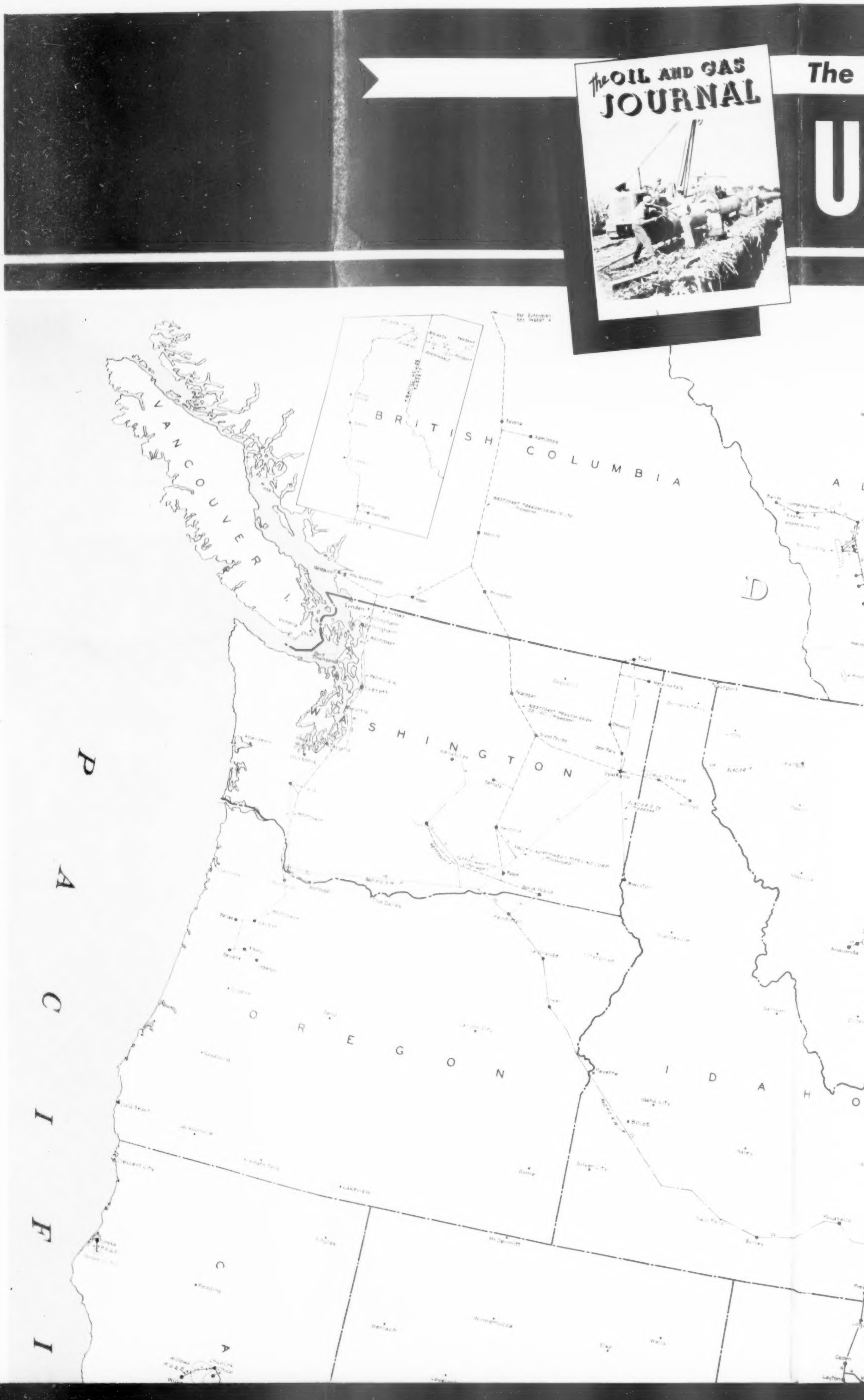
Within hydrocarbon classes they also noted a general tendency for higher-boiling materials to produce more deposit ignition. This was further borne out in tests made on various cuts made from a leaded cat cracked stock. The preignition rate rose substantially as the end point of the fuel increased.

Again, pure hydrocarbons showed pronounced differences in their preignition rates, these differences tended to be submerged when various hydrocarbon blends were tested. Deposit ignition tests run on five refinery stocks and three gasoline blends, all with 3 ml. TEL, showed no conclusive relationship between the deposit-ignition rate and the relative percentages of aromatics, olefins, naphthenes and paraffins in the various fuels.

Preventive measures . . . At present, preignition is a road block, which bars the trend toward higher engine efficiencies through increased compression ratios and higher octane fuels. Its occurrence in certain cars on the road has raised their octane requirements appreciably, although the greater power present in such fuels is not utilized. Hence, the preignition problem must be solved by other means than simple octane increase, if such a step could be called simple.

Probably, the solution will come from a combination of many measures. Engine deposition is one likely avenue. Certain classes of fuels and lubes are known to reduce the deposit buildup in modern engines. Lubes of higher viscosity index will help, and this trend is already under way. Certain lube additives are understood to alleviate deposition, or its tendency to cause abnormal ignition. It is likely that the fight against deposit buildup will be carried mainly through lubes. While alkylate, isooctane and other clean-burning fuels are known to result in fewer engine deposits than for example, catalytic cracked stock, no sizable switch in gasoline components is remotely practical at this time.

A number of automotive lubricating oils now on the market contain additives which suppress both knock and



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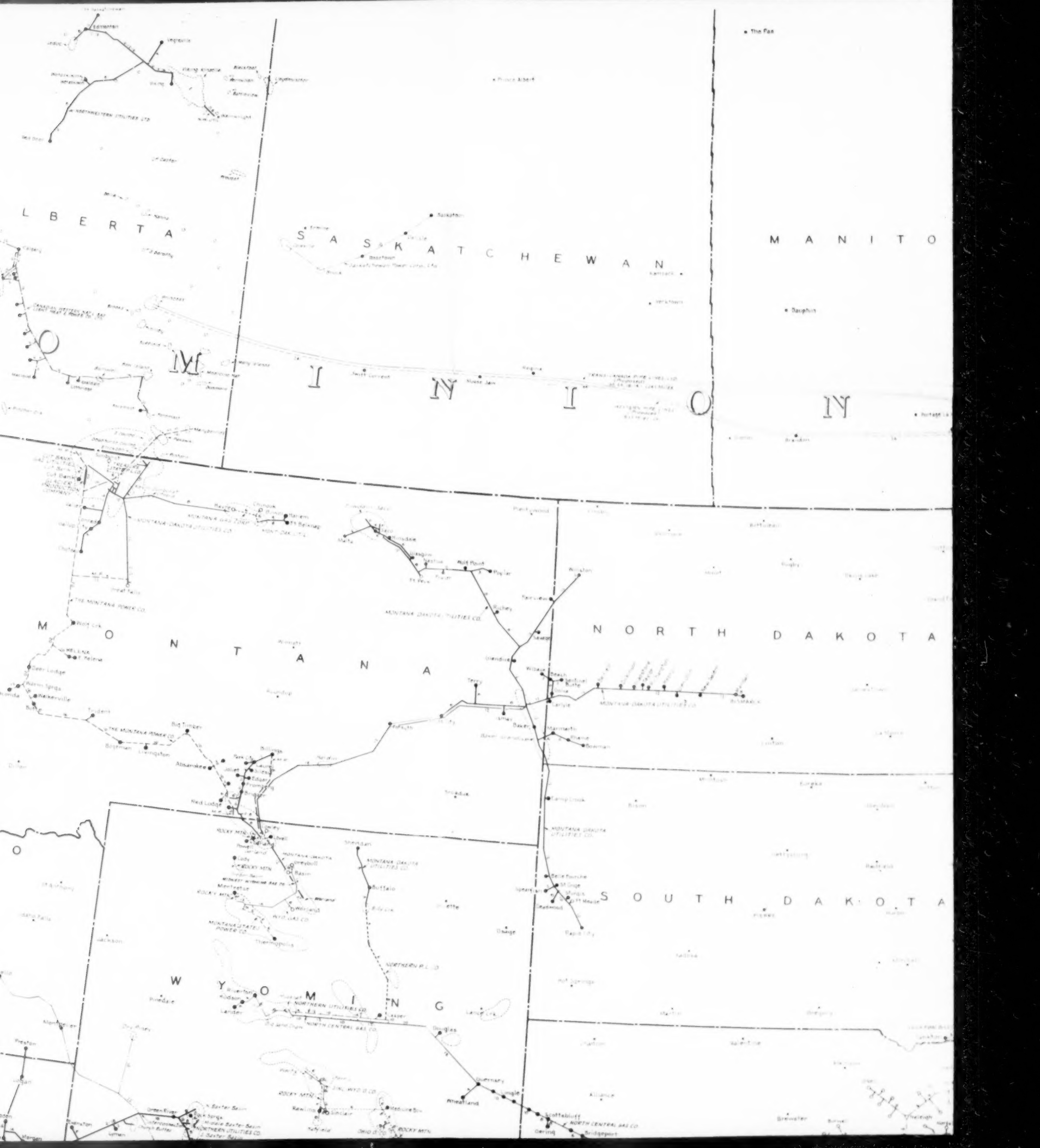

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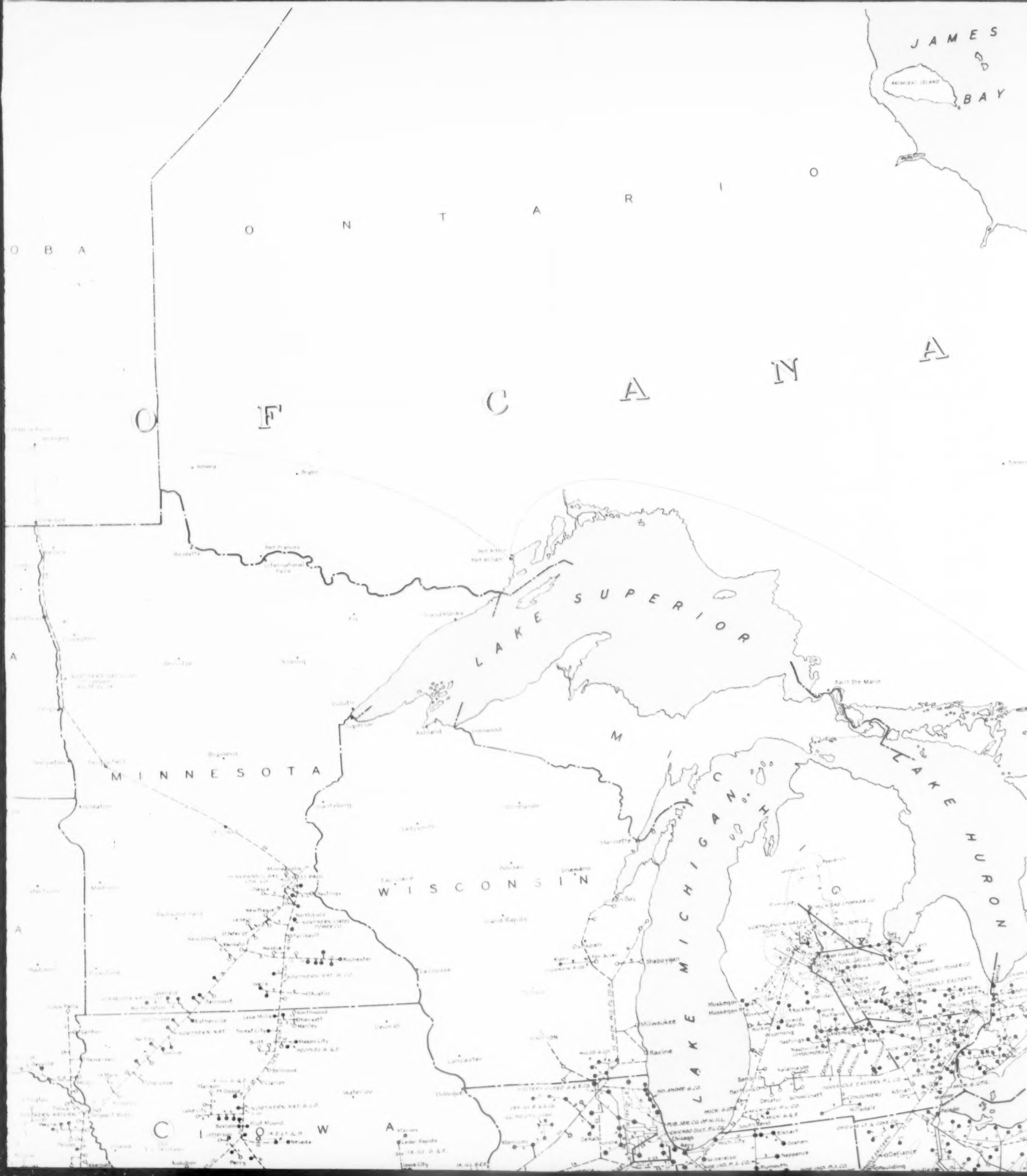
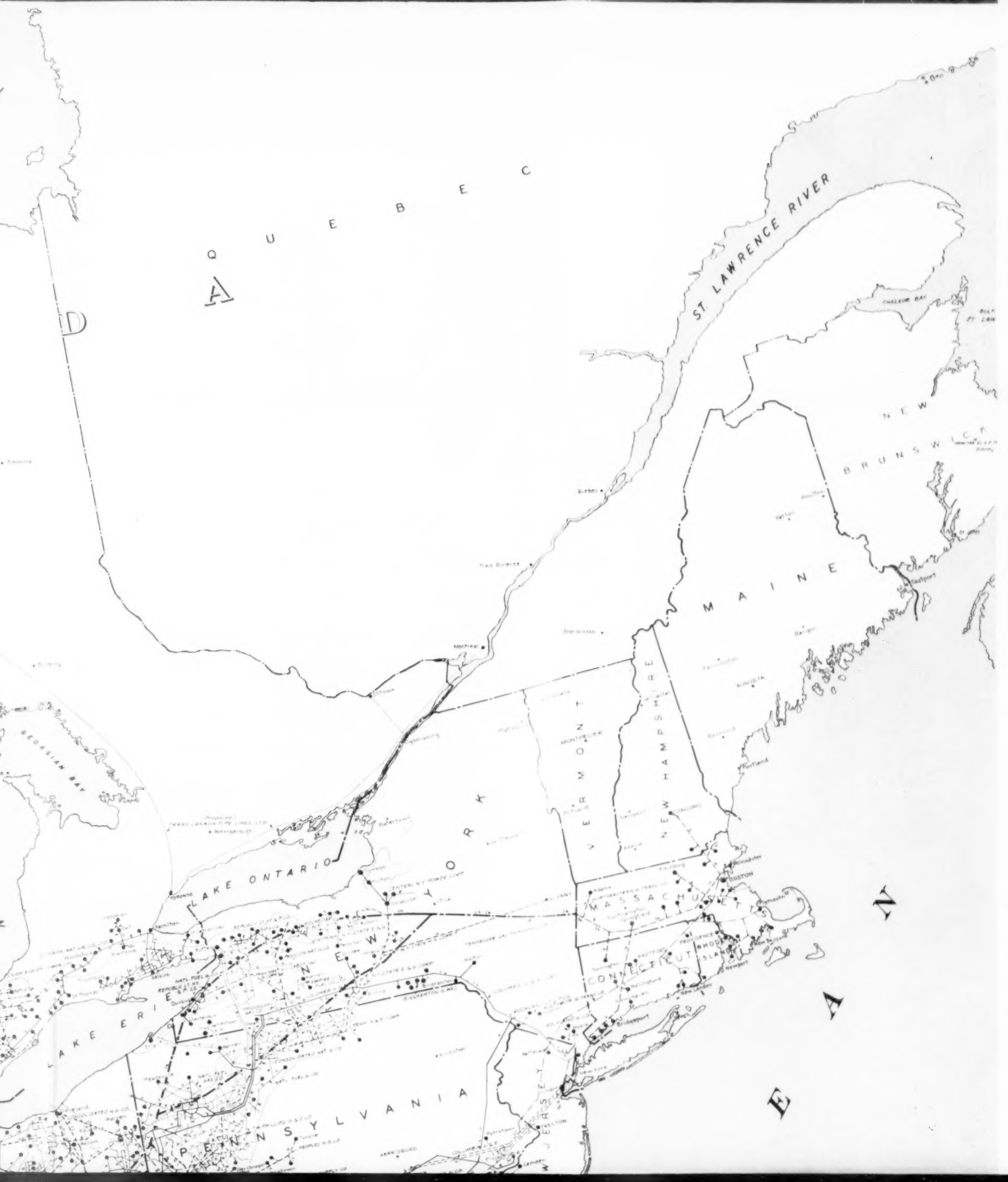
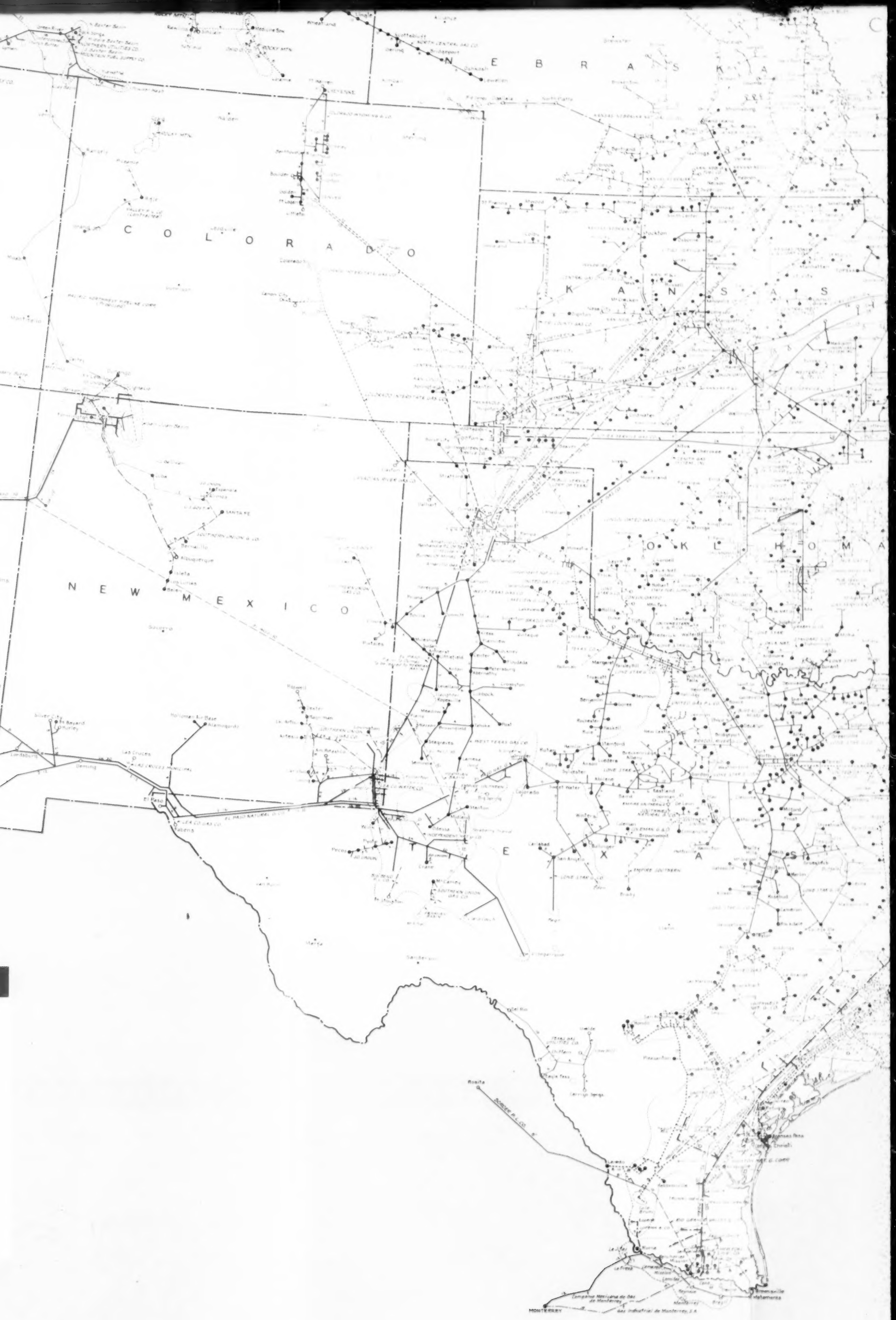


-Line Systems



PRINCIPAL NATURAL-GAS PIPE-LINE SYSTEMS

Alabama Tennessee Natural Gas Co.	Florence, Ala.
Algonquin Gas Transmission Co.	Boston, Mass.
American-Louisiana Natural Gas Co.	Detroit, Mich.
Arkansas Louisiana Gas Co.	Shreveport, La.
Cabot Carbon Co.	Pampa, Tex.
Canadian River Gas Co.	Amarillo, Tex.
Carnegie Natural Gas Co.	Pittsburgh, Pa.
Chicago District Pipeline Co.	Chicago, Ill.
Cities Service Gas Co.	Oklahoma City, Okla.
Colorado Interstate Gas Co.	Colorado Springs, Colo.
Colorado-Wyoming Gas Co.	Denver, Colo.
Columbia Gas System, Inc.	New York, N. Y.
Consolidated Gas Utilities Corp.	Oklahoma City, Okla.
East Ohio Gas Co.	Cleveland, Ohio
East Tennessee Natural Gas Co.	Nashville, Tenn.
El Paso Natural Gas Co.	El Paso, Tex.
Empire Southern Gas Co.	Fort Worth, Tex.
Gulf Interstate Gas Co.	Houston, Tex.
Hope Natural Gas Co.	Clarksburg, W. Va.
Houston Pipe Line Co.	Houston, Tex.
Interstate Natural Gas Co., Inc.	Monroe, La.
Kansas-Nebraska Natural Gas Co.	Phillipsburg, Kans.
Kansas Power & Light Co.	Salina, Kans.
Kentucky West Virginia Gas Co.	Ashland, Ky.
Lone Star Gas Co.	Dallas, Tex.
Michigan Consolidated Gas Co.	Grand Rapids, Mich.
Michigan-Wisconsin Pipe Line Co.	Detroit, Mich.
Mississippi River Fuel Corp.	St. Louis, Mo.
Montana-Dakota Utilities Co.	Minneapolis, Minn.
Mountain Fuel Supply Co.	Salt Lake City, Utah
Natural Gas Pipeline Co. of America	Chicago, Ill.
New York State Nat. Gas Co.	Pittsburgh, Pa.
Northern Natural Gas Co.	Omaha, Neb.
Northwest Natural Gas Co.	New York, N. Y.
Ohio Fuel Gas Co.	Columbus, Ohio
Oklahoma Natural Gas Co.	Tulsa, Okla.
Pacific Gas & Electric Co.	San Francisco, Calif.
Panhandle Eastern Pipe Line Co.	Kansas City, Mo.
Penn-York Natural Gas Corp.	Buffalo, N. Y.
Peoples Natural Gas Co.	Pittsburgh, Pa.
Permian Basin Pipeline Co.	Omaha, Neb.
Pittsburgh & West Virginia Gas Co.	Pittsburgh, Pa.
Rio Grande Valley Gas Co.	Brownsville, Tex.
Rocky Mountain Gas Co.	Casper, Wyo.
Southern California Gas Co.	Los Angeles, Calif.
Southern Counties Gas Co.	Los Angeles, Calif.
Southern Natural Gas Co.	Birmingham, Ala.
Southern Union Gas Co.	Dallas, Tex.
Southwest Natural Gas Co.	Shreveport, La.
Tennessee Gas Transmission Co.	Houston, Tex.
Texas Eastern Transmission Corp.	Shreveport, La.
Texas Gas Transmission Corp.	Owensboro, Ky.
Texas-Illinois Natural Gas Co.	Chicago, Ill.
Transcontinental Gas Pipe Line Corp.	Houston, Tex.
Trunkline Gas Co.	Houston, Tex.
Union Gas System, Inc.	Independence, Kans.
United Gas Pipe Line Co.	Shreveport, La.
United Natural Gas Co.	Oil City, Pa.
West Texas Gas Co.	Lubbock, Tex.
Wilcox Trend Pipe Line Co.	Dallas, Tex.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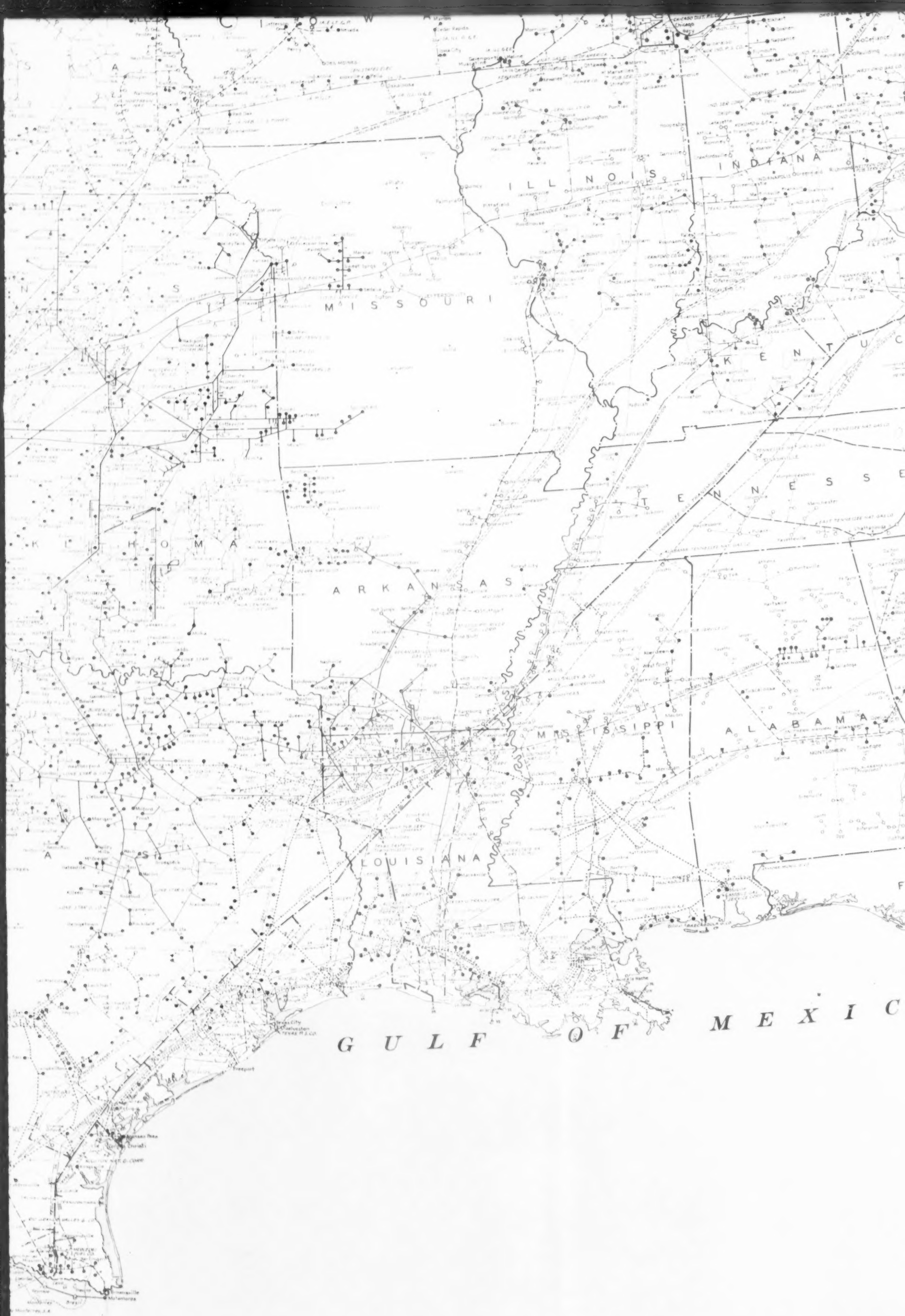
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LEGEND

- Natural Gas Pipe Lines
- Gas Field
- General Gas Area
- Distribution Facilities operated by Pipe Line Company or Affiliate
- Distribution Facilities operated by Other Utilities
- Mixed Gas
- (P) Proposed

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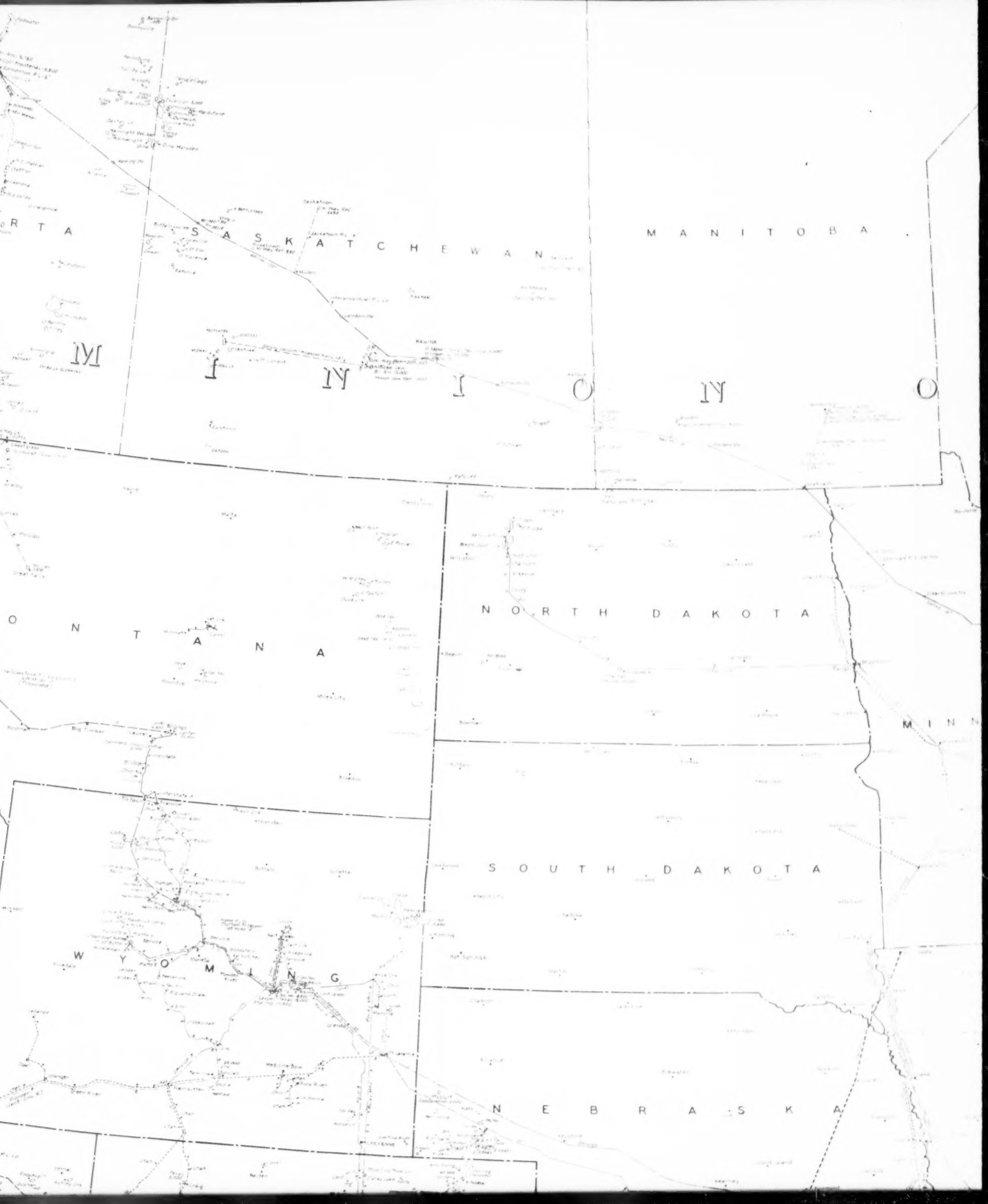

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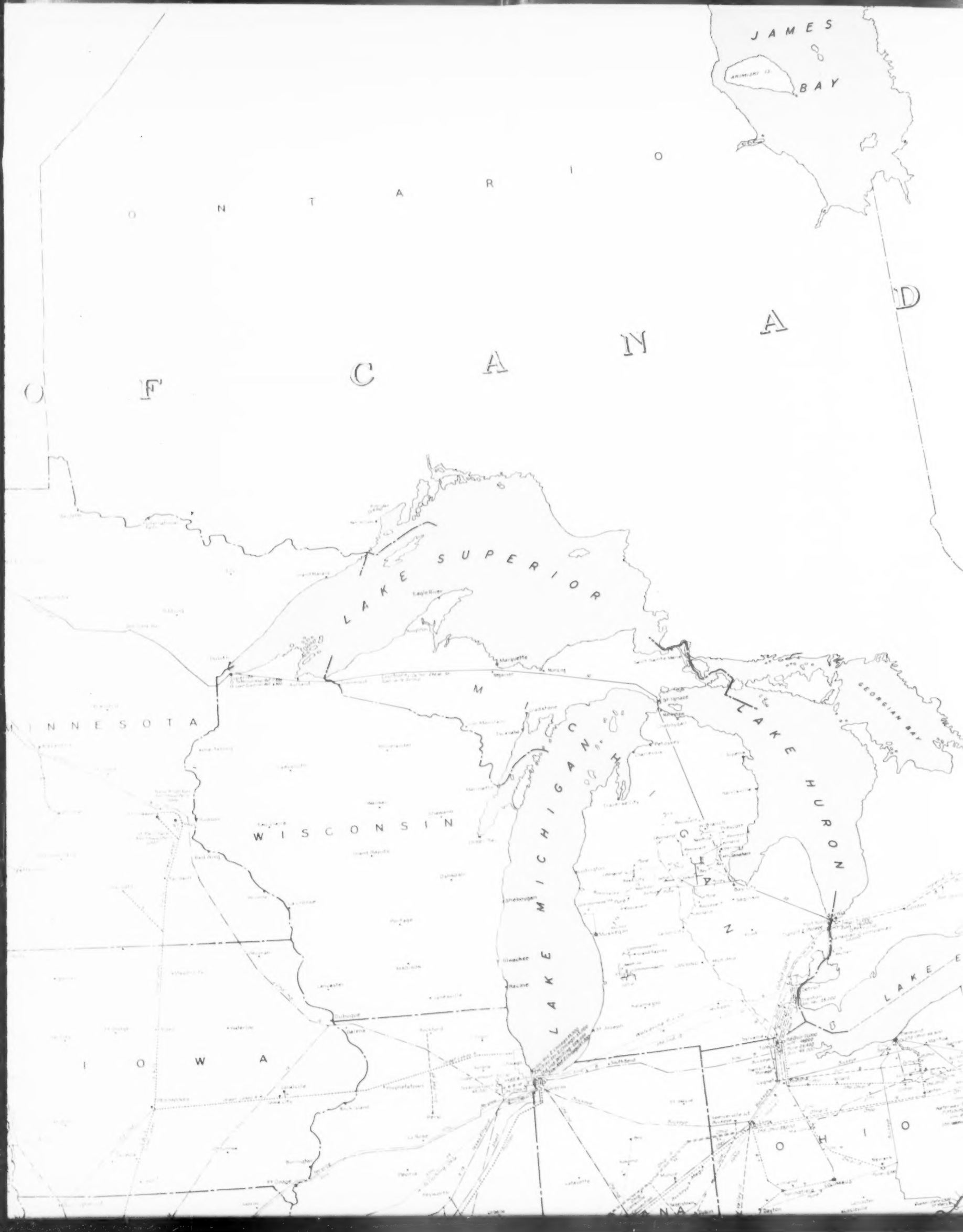

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PRINCIPAL CRUDE-OIL PIPE-LINE SYSTEMS

Ajax Pipe Line Corp.	Tulsa, Okla.	Magnolia Pipe Line Co.	Dallas, Tex.	Socony-Vacuum Oil Co., Inc.	New York, N. Y.
Arkansas Pipe Line Co.	Shreveport, La.	Mid Continent Pipe Line Co.	Tulsa, Okla.	Sohio Pipe Line Co.	Cleveland, Ohio
Atlantic Pipe Line Co.	Philadelphia, Pa.	Mid Valley Pipe Line Co.	Longview, Tex.	Sohio Petroleum Co.	Cleveland, Ohio
Basin Pipe Line System	Houston, Tex.	National Transit Co.	Oil City, Pa.	Sohio Southern Pipe Lines, Inc.	Cleveland, Ohio
Bell Oil & Gas Co.	Tulsa, Okla.	New York Transit Co.	New York, N. Y.	Sohio Western Pipe Lines, Inc.	Cleveland, Ohio
Buckeye Pipe Line Co.	New York, N. Y.	Ohio Oil Co.	Findlay, Ohio	Southern Pipe Line Corp.	Corpus Christi, Tex.
Champlin Refining Co.	Enid, Okla.	Ozark Pipe Line System	Cushing, Okla.	South West Pennsylvania Pipe Lines	Oil City, Pa.
Cities Service Pipe Line Co.	Bartlesville, Okla.	Pan American Pipe Line Co.	Houston, Tex.	Standard Oil Co., of California	San Francisco, Calif.
Continental Pipe Line Co.	Ponca City, Okla.	Pasotex Pipe Line Co.	El Paso, Tex.	Sun Pipe Line Co.	Philadelphia, Pa.
Deep Rock Oil Corp.	Tulsa, Okla.	Phillips Pipe Line Co.	Bartlesville, Okla.	Texas-Empire Pipe Line Co.	Tulsa, Okla.
Derby Oil Co.	Wichita, Kans.	Platte Pipe Line Co.	Kansas City, Mo.	Texas-New Mexico Pipe Line Co.	Houston, Tex.
Eureka Pipe Line Co.	Parkersburg, W. Va.	Portland Pipe Line Co.	Portland, Maine	Texas Pipe Line Co.	Houston, Tex.
General Petroleum Corp.	Los Angeles Calif.	Pure Transportation Co.	Chicago, Ill.	Tide Water Associated Oil Co.	San Francisco, Calif.
Gulf Refining Co.	Pittsburgh, Pa.	Rancho Pipe Line Co.	Houston, Tex.	Tide Water Pipe Co., Ltd.	Bradford, Pa.
Humble Pipe Line Co.	Houston, Tex.	Richfield Oil Corp.	Los Angeles, Calif.	Toronto Pipe Line Co.	Dallas, Tex.
Interstate Oil Pipe Line Co.	Shreveport, La.	Rocky Mountain Pipe Line Co.	Ponca City, Okla.	Transit & Storage Co.	Wayne, Mich.
Kaw Pipe Line Co.	Tulsa, Okla.	Service Pipe Line Co.	Tulsa, Okla.	Valvoline Pipe Lines	Freedom, Pa.
Lakehead Pipe Line Co.	Superior, Wis.	Shell Pipe Line Corp.	Houston, Tex.	Union Oil Co. of California	Los Angeles, Calif.
Leonard Pipe Line Co.	Mt. Pleasant, Mich.	Sinclair Pipe Line Co.	Independence, Kans.	Utah Oil Refining Co.	Salt Lake, Utah
Lion Oil Co.	El Dorado, Ark.	Skelly Oil Co.	Tulsa, Okla.	West Texas Gulf Pipe Line Corp.	Houston, Tex.

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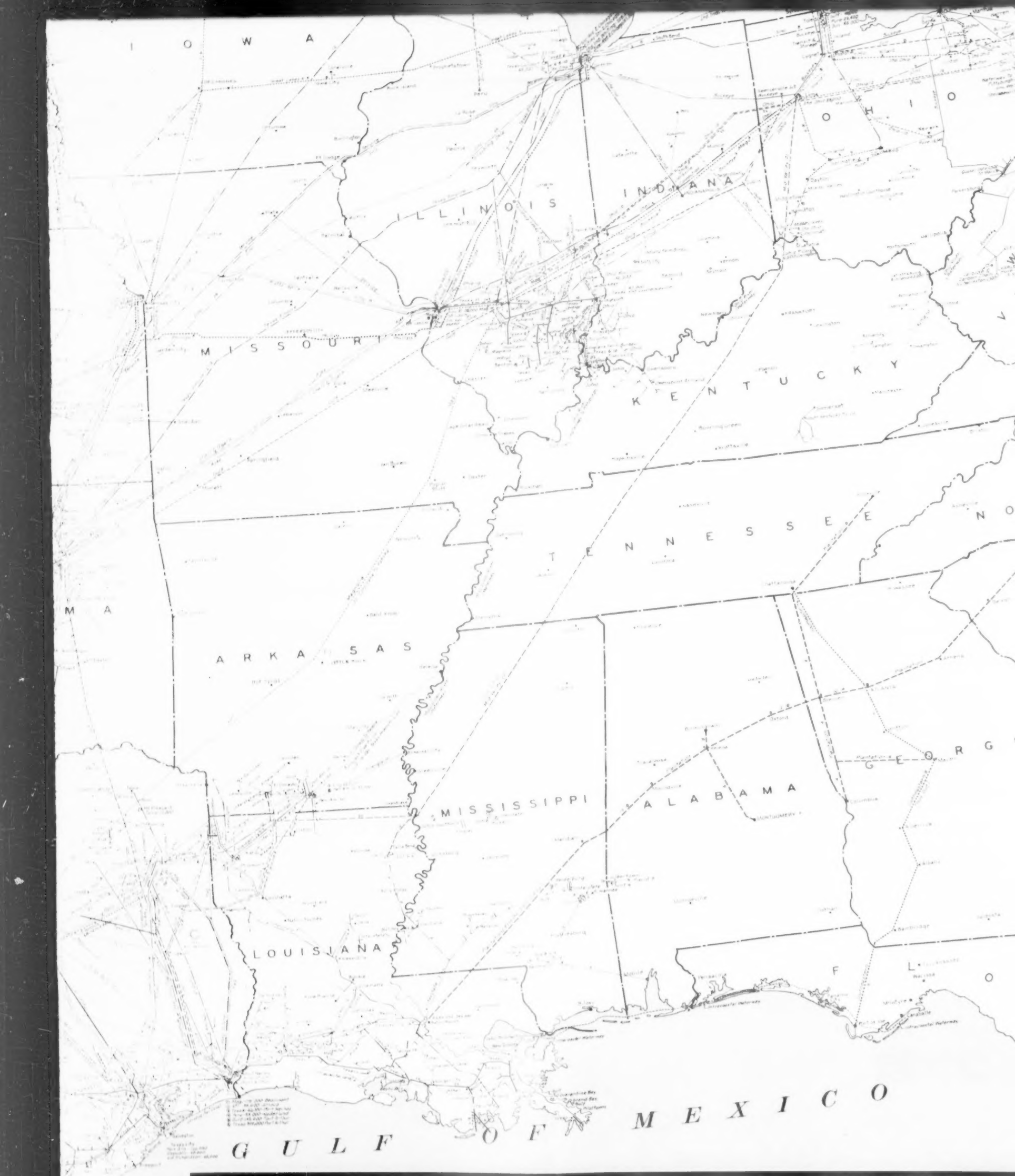
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PRINCIPAL PRODUCTS PIPE-LINE SYSTEMS

Bayou Pipe Line System	Houston, Tex.	National Cooperative Refinery Assn.	McPherson, Kans.	Southeastern Pipe Line Co., Inc.	Atlanta, G
Buckeye Pipe Line Co.	New York, N. Y.	Phillips Petroleum Co.	Bartlesville, Okla.	Standard Oil Co. (Indiana)	Chicago, I
Buffalo Pipe Line Corp.	Philadelphia, Pa.	Pioneer Pipe Line Co.	Denver, Colo.	Standard Oil Co. (Ohio)	Cleveland, Ohi
Champlin Refining Co.	Enid, Okla.	Plantation Pipe Line Co.	Atlanta, Ga.	Sun Oil Co.	Philadelphia, P
Detroit Southern Pipe Line Co.	Chicago, Ill.	Project Five Pipe Line Corp.	Houston, Tex.	Sunray Oil Corp.	Tulsa, Okl
Great Lakes Pipe Line Co.	Kansas City, Mo.	Richfield Oil Corp.	Los Angeles, Calif.	Texas Pipe Line Co.	Houston, Te
Humble Pipe Line Co.	Houston, Tex.	Salt Lake Pipe Line Co.	Salt Lake City, Utah	Triangle Pipe Line Co.	Shreveport, L
Kaneb Pipe Line Co.	Houston, Tex.	Shell Oil Co., Inc.	New York, N. Y.	Tuscarora Oil Co., Ltd.	Harrisburg, P
Keystone Pipe Line Co.	Philadelphia, Pa.	Sinclair Refining Co.	Independence, Kans.	Wolverine Pipe Line System	New York, N.
Magnolia Pipe Line Co.	Dallas, Tex.	Socony Vacuum Oil Co., Inc.	New York, N. Y.	Yellowstone Pipe Line Co.	Ponca City, Okl

PENNSYLVANIA

MARYLAND

DELAWARE

NEW JERSEY

WEST VIRGINIA

VIRGINIA

NORTH CAROLINA

SOUTH CAROLINA

GEORGIA

ATLANTIC OCEAN

St Augustine

Daytona Beach

Palm Beach

Miami

Key West

Atlanta, Ga.
Chicago, Ill.
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Houston, Tex.
Shreveport, La.
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New York, N. Y.
Oklahoma City, Okla.

LEGEND

Gasoline Pipe Lines

Crude Oil Pipe Lines

Cities or Towns

Refinery—15,000 Capacity Bbls. Crude per Day

Waterways

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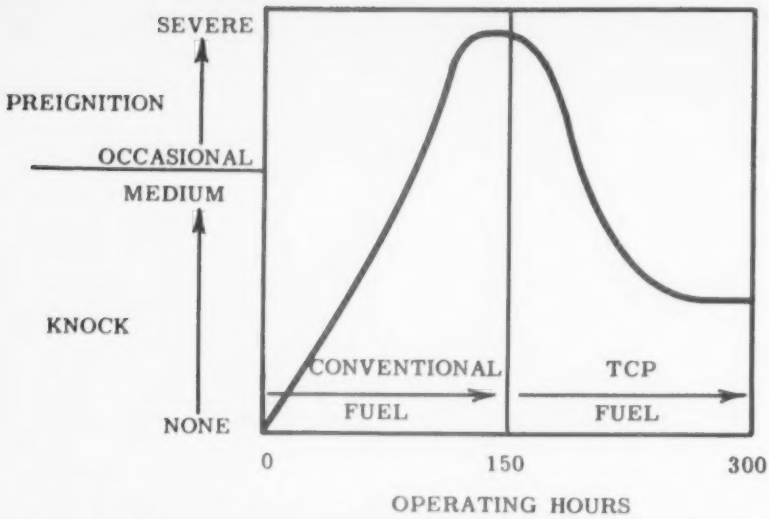
DISTANCE IN HUNDREDS OF MILES



EFFECT OF TRICRESYL PHOSPHATE added to conventional fuel is illustrated schematically from knock and preignition tests conducted by Shell on automotive engines.

preignition. Some contain phosphorous additives. In such cases, the added benefits derived from phosphorous additives in the fuel are difficult to ascertain. In due time the relative benefits from adding phosphorous and other additives to lubes and fuels will be better evaluated.

Engine design important . . . Much responsibility for lessening this problem lies with the engine designers. The shape of the combustion chamber affecting turbulence and passage of the charge is understood to have a definite relationship to engine deposition. Unfortunately, some engine designers consider combustion chamber design as an art and not a science. They say that minor alterations in contour do affect deposition, but without any rhyme or reason. Hence an Edisonian trial-and-error sort of procedure seems in order, with no clues to solution apparent, or at least reported.

However, preignition studies to date have revealed two important points where improved engine design can definitely help. Improved oil control is one. A particularly bad actor among the new 1953 cars preignition-wise is understood to have been improved measurably by changing ring design.

Surface finish in combustion chambers can also affect deposition. In road testing a certain 1953 model, Sun engineers found that two of the eight cylinders were consistently showing preignition, while the remainder were relatively free of wild ping and other effects. Examination of the engine showed that no two cylinders had the same dome surface smoothness, and the two bad actors were the ones with the most surface irregularities.

These isolated cases indicate that perhaps engine designers are guilty of sins of omission, in devoting insufficient attention to the preignition tendencies of their cars. Some observers in the oil industry consider it high time for a new look at engine design and for that matter, engine testing.

Auto makers are now believed to be increasingly cognizant of the need for testing their cars under realistic conditions which contribute to preignition. As a result, some are subjecting their cars to extensive low-duty, stop-and-go operation which much more closely represents severe use from both preignition and the knock standpoints. This is the critical type of test, rather than the high speed hard driving desert tests often considered as "severe." It is now conceded that the used-car dealer's classic "elderly school teacher who never drove over 30," probably turned in one of the dirtiest engines on the lot.

Temporary measures . . . A number of methods are now available for cleaning engines of deposits, and more are on the way. This approach to the problem effectively alleviates both preignition and common knock problems by returning an engine to a state approaching its condition when new and clean. It erases the octane requirement buildup, but of course does not prevent subsequent deposition, and hence is a temporary measure.

The use of solvents, and the rice-blasting technique, both administered at the garage level, will clean an engine. They offer no long-range solution to the problem since they do not prevent deposition or reduce its rate of buildup in the first place.

A stop-gap prescription given some motorists saddled with preignition, is to get the car out on the road and give it some hard driving. In fact one auto manufacturer recommended the alleviation of wild ping by accelerating the engine through its speed range several times in succession. This type of operation admittedly removes some deposits built up on the so-called "beauty parlor run," but again it does not offer basic relief.

Lead salts . . . Certain lead salts formed from tetratehyl lead have proved to be the principal catalyzing agents which cause carbonaceous deposits to glow and preignite the fuel. So, a promising attack on the problem appears to be through the fuel additive route. In grading lead salts for their tendencies to promote carbon glow, lead oxide and lead oxyhalide rate high while lead phosphate reduces glow nearly to the low level of carbon alone. This has lead to a thorough investigation of phosphorous additives. Wartime research revealed that tricresyl phosphate reduced spark plug fouling in aircraft engines and at the same time reduced the preignition tendencies of engine deposits. Later studies of the effect of tricresyl phosphate in motor fuels verified its beneficial effect in suppressing preignition in automotive engines.

Fairly extensive field tests confirmed laboratory findings. One test in particular is reported, to illustrate road results. Two 1951 model cars were operated for 150 hours on conventional leaded fuel. Gradual deposit accumulation first increased knock intensity to medium. Preignition became evident shortly before 100 hours, and progressed to the severe state. Within a few hours after introduction of tricresyl phosphate at the 150-hour mark, preignition ceased completely, and knock was reduced, although not entirely eliminated.

Other phosphorous compounds are undergoing intensive testing in many laboratories throughout the country. While this element is a present favorite, others are also under scrutiny, based on their known properties for suppressing temperature and duration of carbon glow.

What will come out of this fairly widespread research work is not yet known, since those involved are obviously not calling their shots until they are thoroughly satisfied with results of their findings. Before a new additive can be introduced publicly, it must pass muster with many qualifications involving availability, cost, attendant effects on engine wear and operation, and practical performance.

As a result, even intensive research spurred by brisk competition cannot be expected to deliver immediate and final solutions to the problem for all

concerned. One refiner is understood to be ready to introduce a new gasoline additive this fall. How many others may be that close to commercial application, is not presently known.

The two manufacturers of tetraethyl lead, closely concerned with this problem, are known to be well under way with additive test work. Du Pont reported last spring on three unrevealed additives which showed significant reduction in glow duration. A fourth additive which they termed "Z," showed up as outstanding in laboratory tests—reducing glow duration to almost zero time, at the same time appreciably increasing glow initiation temperature. Ethyl report that they have under test several additive candidates which show similar effects in the laboratory.

Both companies seem well on the way toward development of additives which will be incorporated with the tetraethyl lead they sell to customers. When these improved TEL blends will be made available they do not say, although obviously neither is presumably dawdling on the job.

Meanwhile, some refiners plan to improve fuels by blending new additives of their own, and some are understood to be planning to market hydrocarbon blends which will alleviate the preignition problem by one means or another. Many of these rumored new fuels will involve manufacturing and blending know-how and will not be revealed in detail.

The problems concerned with preignition may well spark the most extensive new developments in fuels and lubes to come out of research laboratories in several years. The oil industry is rapidly becoming preignition-conscious and future product qualities relating to this problem will gain increasing attention. In the long run, the attack on preignition may well contribute bonus benefits in combating the common knock. The industry as a whole has not arrived at a firm long-range solution yet, but it will.

MEETINGS

Drilling Contractors to Meet

DENVER.—The annual meeting of the American Association of Oilwell Drilling Contractors is scheduled for October 3-6 at the Cosmopolitan Hotel here.

Among the addresses programed for the meeting will be "The Banker and the Drilling Contractor," Eugene McElvaney, First National Bank, Dallas, and "History of Rocky Mountain Oil Development," by Tom Dougherty, Petroleum Information, Inc., Denver.

Technical papers will include "Application of Power Pumps to High-Pressure Drilling," R. J. Meers, Loffland Brothers Co., Tulsa, and "Methods of Sealing Vugular and Cavernous Formations," P. P. Scott, Jr., Stanolind Oil & Gas Co., Tulsa.

A symposium on "Drilling Fluids" will feature the afternoon session of the meeting's final day.

Geologists Plan Meeting

WICHITA, Kan.—More than 1,500 geologists from Oklahoma, Kansas, Texas and Nebraska will attend the Mid-Continent regional meeting of the American Association of Petroleum Geologists here September 30-October 2.

John Emery Adams, president of A.A.P.G., will present a technical paper on carbonate rocks in addition to his presidential address. Adams, senior geologist, Standard Oil Co. of Texas, Midland, will also act as moderator of a symposium on carbonate reservoirs.

Registration for the meeting will open September 30 and technical meetings will begin October 1 and continue through October 2.

P.E.P.A. to Meet October 5-7

KANSAS CITY.—The Petroleum Electric Power Association will hold its silver anniversary meeting at the Muehlbach Hotel here October 5-7.

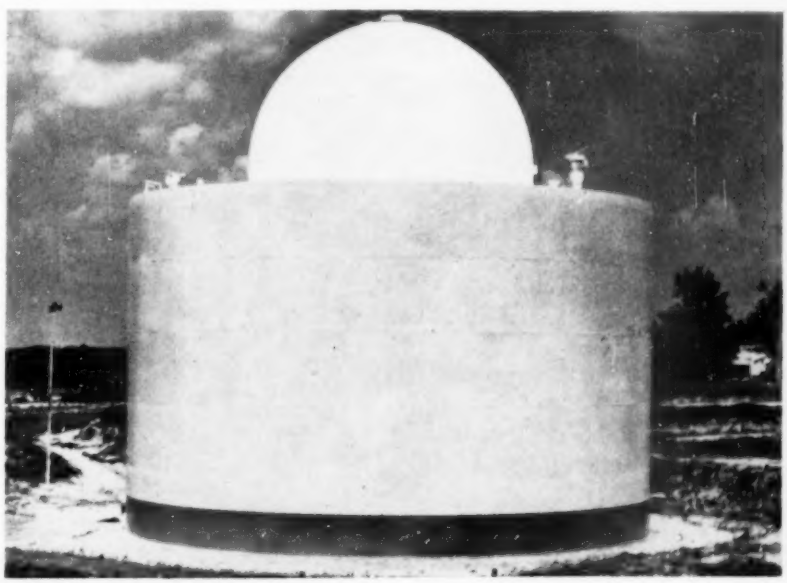
The association was founded 25 years ago here by a group of oil and utility men who wished to share their problems and knowledge of power in producing, refining, and pipe-lining oil. The following papers in these fields will be presented:

"Twenty-Five-Year Growth of the Use of Purchased Electric Power in the Petroleum Industry," Mitchell Tucker, vice president of The Oil and Gas Journal, Tulsa; "Power Distribution Trends in a Refining Industry," W. B. Wilson, General Electric Co.; "Electric Motor Design and Proper Application in the Oil and Gas Industry," Edward F. Griewe, Allis-Chalmers Manufacturing Co.; "Economics and Experience With Purchased Power in a Refinery," T. R. Shaw, Phillips Petroleum Co.; "Description of Automatic Controlled Pumping Stations," Fred S. Jones, Platte Pipe Line Co.; "Your Electric Design of Pipe-Line Pumping Stations for Safety Under Hazardous Atmospheric Conditions," Merritt Hyde, Westinghouse Electric Corp.; "Electric Power for Products Pipe-Line Pumping," P. R. Madden, Great Lakes Pipe Line Co.; and "New Techniques in Oil Production," Ralph Spearow, president of Spearow Co.

I.P.A.A. to Discuss Imports

FORT WORTH.—A program to combat the problem of oil imports will be the major concern of the Independent Petroleum Association of America when it meets here October 19-20.

The membership of the meeting, expected to be more than 1,000, will hear a report from a 41-man import-policy committee which meets in Fort Worth September 23. The committee will examine import figures and trends in relation to depressed domestic oil production and then report to the I.P.A.A.



Money Saver for Product-Storage Operations

Loss of volatile products to the atmosphere as a result of expansion and contraction caused by outside temperature changes is minimized by this type of superstructure on storage tanks. At the base of the vapor dome is an elastic diaphragm which expands as the pressure in the tank increases, collecting in the dome the vapors which normally would be vented. This installation was completed recently at the Spartanburg, N. C., distribution center of Shell Oil Co.

LATIN AMERICA

Oficina Getting Bigger

Wildcatting program extending big Venezuelan producing area eastward; several companies involved in oil search

THE Greater Oficina area of Anzoategui State, in eastern Venezuela, where oil fields have mushroomed since the original Oficina field discovery in 1937, is currently being extended eastward by the wildcatting efforts of several companies.

Venezuelan Atlantic Junta-2, 15 miles northeast of Mene Grande's Leona field, has now been completed for 500 bbl. per day of over 20° gravity on ¼-in. choke. The hole reached a final depth of over 8,600 ft. and testing continued upward until production was found.

Junta-3 was immediately spudded at a point 500 yards southwest of the discovery well. Meantime, Junta-2 has been closed in until the productive possibilities of the area are better known. Some 15 miles of pipe line will have to be built to tie this oil into the Mene Grande gathering system.

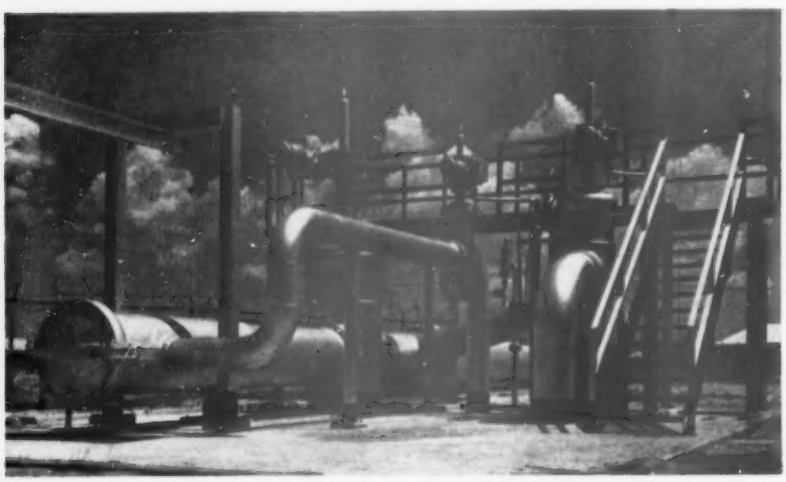
The Junta discovery gives Atlantic its first production in the State of Anzoategui since the small Pelas-Pelayo field was abandoned 3 or 4 years ago. The bulk of Atlantic's production comes from scattered fields in eastern Guarico. The activities at Junta are being conducted at a distance of about 75 miles from the main base of operations.

Pancoastal testing . . . Pancoastal's first independently drilled well, PCXP-1, is in this same general area but closer to the Leona wells. It has reached final depth of 8,100 ft. and is now being tested. Side-wall samples indicated a number of prospects, and it is planned to test them thoroughly. Up to the present, Pancoastal has had no production of its own, receiving about 6,000 bbl. a day from joint operations conducted by Venezuelan Atlantic. PCXP-1, however, is on acreage owned 100 per cent by Pancoastal.

Mene Grande completion . . . Northwest of the area of these two wells, Mene Grande has just completed Nigua-1 from two sands for a combined total of 1,250 bbl. a day of oil about 35° in gravity. This well, drilled to almost 12,000 ft. in spite of a plague of mechanical difficulties, is on acreage where American Maracaibo has a 20 per cent overriding royalty. A second well was immediately spudded, and prospects for a sizable field of premium-grade oil are good.

Six miles east, Mene Grande Zorro-1 has discovered a new pool in its first test after reaching final depth of over 11,000 ft., gaging 500 bbl. a day. Several other sands up the hole are said to look equally promising.

Zorro-1 is east of the Mata-3 area discovered by The Texas Co. last year. Socony-Vacuum recently spudded North Mata-1. Other companies with offsetting acreage are expected to extend the Mata area considerably in other directions in the next few months.



Shell Line Moves Large Portion of Maracaibo Crude

This modern equipment is a part of a system of three big-inch pipe lines that now moves approximately half of the total production of the Lake Maracaibo area of western Venezuela. The view shows the outgoing manifold with scraper trap of the 30-in. Shell light-oil line at Palmarejo de Mara. The three pipe lines built out of the lake area in the last 5 years—the Shell line and Creole Petroleum Corp.'s parallel 26-in. lines—terminate at refining and deep-water terminal facilities on Paraguana Peninsula. Formerly all lake production was taken over the Maracaibo bar in shallow-draft tankers and then transferred to ocean-going vessels.

McCarthy to Drill in Bolivia

Glenn McCarthy, Houston oil operator, expects to begin drilling on a 970,000-acre concession in Bolivia by November.

Much of the $500,000 worth of equipment which will be used in the exploration and drilling operation has already been delivered and is stored in Houston. The remainder will soon be shipped to Houston from Cardwell Manufacturing Co. at Wichita.

McCarthy plans to set up all the equipment here for testing. Then it will be dismantled and shipped to Bolivia. This will take about 2 weeks, and the entire shipment is expected to be loaded within 30 days.

Drilling of shallow wells in the Los Monos area of southwestern Bolivia will be the first operation. McCarthy plans to fly to Bolivia in October with a number of technicians.

Drilling in Peru Planned

Peruvian Pacific Petroleum Co., a wholly owned subsidiary of Cities Service Co., has acquired approximately 300,000 acres of exploration and development land in the Talara producing area on the coast of northern Peru.

The acquisition was under a contract with Empresa Petrolera Fiscal, the Peruvian Government oil company.

Peruvian Pacific also has entered filing on 20 exploration concessions totaling 2,405,000 acres in the Montana region of eastern Peru. In the same area Texas Petroleum Co. (Peru), Socony-Vacuum Oil Development Co. (Peru), and Richmond Oil Corp., a Standard Oil Co. of California subsidiary, have recently made applications for similar tracts.

The new Cities Service subsidiary is entering into a working agreement with

Richfield Oil Corp. whereby each company will participate in the exploration and development on a 50-50 basis. In the initial stages, the principal operations will be geological work and exploratory drilling.

Union to Explore Costa Rica

An extensive drilling exploration program over 4,500,000 acres in two provinces in Costa Rica will be undertaken by Union Oil Co. early in 1954.

Union entered the oil picture of Costa Rica by acquiring controlling interest in Compania Petrolera de Costa Rica, Ltda. in return for conducting exploratory work. The company was formed by Costa Rican citizens 2 years ago.

Concessions of 2,000,000 acres in Limon Province and another 2,500,000 acres in Guanacaste Province were granted the company by the Costa Rican Government after negotiations. It was necessary for a special act of the congress to ratify the contract.

Royalty provisions of the contract provide for the Costa Rican Government to receive a percentage of each day's oil production. The contract also provides that no oil be exported until the domestic needs of the country are satisfied.

EUROPE

German Cat Unit on Stream

A new catalytic cracking unit of the Kellogg Orthoflow design has been completed and placed on stream at the Scholven-Chemie, A.G., plant at Gelsenkirchen-Buer in West Germany.

Plant capacity is now sufficient to process the full 400,000 tons annually (about 8,000 bbl. daily) provided for in the plan of the Organization for European Economic Cooperation. A revised plan of the German Refiners Association for 1953 calls for a throughput of 178,200 tons of German Emsland crude and 130,000 tons of Kuwait crude. The German crude is moved via Rotterdam to Duisburg and by pipe line to the Scholven works.

During the last year, the Scholven hydrogenation equipment has topped Emsland crude and the residue treated by 300 atmospheres hydrogenation (combination phase) to give hydrogenated gasoline and diesel oil. Completion of the new catalytic cracking unit now permits the additional intake of Kuwait crude.

The unit, which represents the first phase of expansion and modernization of the Scholven plant, was built by the German firm of Friedrich Uhde, G.m.b.H. Cracking residues, together with topping and vacuum distillation residues, are run to the combined hydrogenation for processing into further quantities of gasoline and diesel oil. Propylene from the gases will be converted into acetone by Phenol-Chemie Zweckel.

MIDDLE EAST

A.I.O.C. Loses Round

Japanese court refuses to ban imports of Iranian oil

LEGAL claims of Anglo-Iranian Oil Co., Ltd., to oil exported from southern Iran received a setback September 11 in Tokyo when a Japanese appellate court rejected the company's request for an injunction against Idemitsu Kosan Co.

Anglo-Iranian sought a court order which would have blocked the further sale of products imported by Idemitsu into Japan from Iran. Idemitsu made the purchases under a deal with the National Iranian Oil Co. which is operating the nationalized properties of Anglo-Iranian as an agency of the Iranian Government.

The Tokyo appeals court held that the Iranian nationalization law could not be held to be confiscatory, and also that there was no basis for the courts of one country passing judgment on the validity of the laws of another sovereign state.

The decision sustained a previous denial of the injunction several months ago by a Japanese district court. In Italy, Anglo-Iranian lost in a lower court in an effort to obtain a sequestration, or impounding, order, against an Italian firm which had imported Iranian oil. However, the British company has taken further legal action.

Political influence . . . Although Anglo-Iranian has so far lost in court—except last year at Aden in the case of the Rose Mary—Britain's own economic and political influence is throttling off even the small-scale shipments which Iran has been able to make. The Italian Government has not issued import licenses for the oil brought to that country, and Japan has indicated it will grant no further foreign exchange to Idemitsu for the purpose of buying Iranian oil.

Latest reports from Tokyo are that Idemitsu's tanker, Nissyo Maru, was scheduled to leave Japan September 10 on her fourth trip to Abadan to lift Iranian oil, and that the Idemitsu-chartered tanker, Koei Maru, docked at Kawasaki last week with its first load of oil from Iran.

Iran's new attitude . . . Meanwhile, in Teheran, the increasing shift of Iran to Western, non-Communist policies was reflected in the government's move against a Russian citizen described as an oil operator. The Zahedi government sent the Soviet embassy a military report on his activities in Gorgan, near the southeastern corner of the Caspian Sea, and asked the Russians to send him home. He was identified as having been connected with the now-liquidated Soviet company, Iransov Naft, which formerly marketed Russian products in northern Iran.

Iraq Concession Explored

Khanaquin Oil Co., Ltd., is carrying out a renewed program of exploratory work on its concession in eastern Iraq.

The company, a subsidiary of Anglo-Iranian Oil Co., Ltd., cemented 13⅜-in. casing recently in its deep test, C.S. 9, Chia Surkh. The operation took 130 tons of cement, said to be the largest volume used on a single job in the Middle East.

The well is a part of deep exploration below the Kalhur limestone which is also being carried out at Naft Kaneh field. The area being tested is where W. K. D'Arcy first started drilling in December 1902 before he made the major Iranian discovery at Masjid-i-Suliaman in 1908. At Naft Kaneh, it was not until 1951 that tests on No. 7 proved the existence of an oil reservoir in the Kalhur limestone, the present producing formation.

The Alwand refinery and the Khanaquin oil depot serving the Naft Kaneh field became the property of the Iraq Government in December 1951 under an agreement between the government and the company. Khanaquin continues to operate the refinery on behalf of the Iraq Government.

International Briefs

Burmese Government military forces have freed British-owned oil fields at Yenangyat in Central Burma, according to a report from Rangoon. The area, near other British-owned fields at Chauk, has been in rebel hands since 1948.

D'Arcy Petroleum Co., Ltd. (Anglo-Iranian) is continuing its exploration program in Britain with a new test at Plungar, about 23 miles southeast of the company's small producing fields in the Eakring area. At Screveton, south of Newark, the company has discontinued a test which was taken to 3,621 ft. without finding paying production.

PERSONALS

Young Executive

Marshall is vice president of Quintana Petroleum

AT the age of 35, Douglas B. Marshall is serving in a highly important and responsible position in an oil company which has its operations spread over seven states — most of them in the Rocky Mountain area.

The young business dynamo is vice president of Quintana Petroleum Corp., a company which has been highly successful. Operations are carried on in Texas, Montana, Colorado, Wyoming, Nebraska, North Dakota, and Utah.

Marshall began his career in the petroleum industry in a humble way —as a draftsman. But he took on these chores with vim and vigor, and soon rose with the company to his present position. All of his business associates respect him for his administrative ability.

In addition to his post with Quintana, Marshall is a member of the board of directors of the Second National Bank of Houston, and serves on the boards of a number of smaller companies.

He attended the University of Minnesota, where he studied aeronautical engineering, and he often relates—and is proud of the fact—that he earned his way by traveling throughout the Midwest and South selling seeds.

While oil is his major interest, Marshall is an accomplished sportsman and is interested in many subjects, including the price of cattle and the condition of the Texas soil.

A member of St. John the Divine Episcopal Church, Marshall, with his wife and their two boys, reside in Houston. Marshall is an active civic worker, devoting considerable time to the Texas Heart Association, as chairman of its board of directors. He also is a director of Jefferson Davis Hospital, and is on the boards of directors of the Texas Children's Hospital, the Shrine Crippled Children's Hospital and the United Fund.

E. C. Dillard, production foreman for The Texas Co., has been transferred from Fairfield, Ill., to Caldwell, Kans.

E. A. Cornelius, tool pusher for General Geophysical Co., has been transferred from Rotan to Sweetwater, Tex.

Tatham R. Eskrigge, formerly with the production division of Gulf Refining Co., New Orleans, has opened offices as a geological consultant in New Orleans.

William S. W. Kew, formerly chief geologist for Standard Oil Co. of California, has opened offices in San Francisco as a consulting geologist.

Earl J. Newlin has been elected president of State Fuel Supply Co., Oklahoma City. He had been vice president since 1950 and was general manager for 5 years prior to that. Newlin joined the company in 1930 and also is secretary of the Southern Gas Association. **L. E. Ferguson,** superintendent of company operations, succeeds Newlin as vice president but also will retain his present position.

Arnold F. Koening, tool pusher for Noble Drilling Co., has been transferred from Edgerton, Wyo., to Powell, Wyo.

R. C. McMahan is now district engineer in Sunray Oil Corp.'s Oklahoma production district at Oklahoma City. He has been senior engineer in the firm's Kansas production district at Great Bend.

Walter Q. Cline, formerly a geologist for Stanford Oil Co., Evansville, Ind., is now with Cities Service Oil Co. at Lovington, N. M.

R. W. Stewart, district superintendent for Magnolia Pipe Line Co., has been transferred from the company's Luling, Tex., district to the Midland district. **H. M. VanBuskirk** has been transferred from the Midland to the Luling district as district superintendent.

Ben Lovell, junior engineer for Sunray Oil Corp. in Benton, La., has been promoted to chemical engineer in Aransas Pass, Tex.

Thomas A. Gwynn has been appointed a geologist for Montana-Dakota Utilities Co. in Minneapolis. He formerly was with the Federal Power Commission in Washington, D. C.

Homer N. Lewis, district superintendent for Ohio Oil Co. in Chickasha, Okla., has been promoted to division superintendent in Tulsa.

Leon A. Davis, petroleum engineer for Magnolia Petroleum Co.'s Shreveport producing district, has been appointed assistant production foreman in that district.

Willard Wilson, tool pusher, has been transferred from Guymon, Okla., to Elkhart, Kans., by Holm Drilling Co.

D. K. Harger has been named general manager of Standard Oil Co. of California's El Segundo refinery. He succeeds the late C. A. Pollard, who held the position for 2 years until his death in August. Harger had been manager of operations since 1946 and joined the company in 1926. In 1931 he was made foreman of the experimental laboratories and in 1934 he was transferred to the manufacturing department. He became superintendent of process control at the company's refinery at Richmond, Calif., serving there until returning to El Segundo as manager of operations.

Robert B. Stobaugh, Jr., chemical engineer in the New York office of California Texas Oil Co., Ltd., has been transferred to the Bahrein refinery in the Persian Gulf.

Ralph Howe has been appointed division geophysicist of the northwestern division of The California Co. at Bismarek, N. D.

Paul Kuhl, formerly director of foreign refining for the Petroleum Administration for Defense, has been named director of refining and natural gas. He also will serve temporarily as acting director of the production, and supply and transportation divisions.

PERSONALS

Delma Baucum, formerly assistant district superintendent for Humble Oil & Refining Co. at Snyder, Tex., has been promoted to district superintendent at Wink, Tex.

Clarence Norman, formerly district engineer for Humble Oil & Refining Co. at Tulsa, has been made a technical service engineer for the firm at Houston.

Hugh R. Kirkpatrick has resigned as a reservoir engineer for Cities Service Oil Co., at Oklahoma City, to become a sales engineer for Black, Sivalls & Bryson at Kilgore, Tex.

Raymond C. Hunt, formerly with Texas Eastern Transmission Corp., has joined Gulf Interstate Gas Co. as assistant division engineer at Alexandria, La.

William L. Fanning, Jr., has been promoted by Tide Water Associated Oil Co. to products-loss engineer with the company's fire protection and safety department at New York. Fanning joined the firm in 1946 and had been manager of the transportation and supply department since 1949.

Wilford Lee Stapp, formerly district geologist for Sunray Oil Corp. at Abilene, Tex., has been transferred to Lake Charles, La., as district geologist. He replaces **William Easley,** who has resigned. Stapp has been with Sunray since 1946 and had been at Abilene since 1950.

William N. Zakis, formerly at Durango, Colo., has been promoted by Continental Oil Co., to district geologist with headquarters in Casper, Wyo. He succeeds **Gerald F. Bowers,** who has resigned.

J. R. Nichols, gas-plant superintendent of Humble Oil & Refining Co.'s compressor plant at Seeligson, Tex., has been transferred to the firm's gas plant at Opelousas, La. He replaces **H. D. McClain,** who has been moved to the Katy, Tex., gas-cycling plant as assistant superintendent. Other changes include: **J. W. Smith,** petroleum engineer at Livingston, Tex., to Colorado, Tex.; **J. A. Reed,** who has returned from military leave, to the Galveston Bay district of the Gulf Coast division as a petroleum engineer; **Horace C. O'Rear,** tool pusher, from the Kelsey, Tex., district to the Scott and Hopper district, Southwest Texas division, and **H. M. Lemex, T. V. Miller,** and **R. A. Watson,** petroleum engineers at Houston, to the Gulf Coast division office.

International Guests of Los Angeles Nomads

International guests at the regular September dinner meeting of the Los Angeles chapter of Nomads were: Standing, left to right, Leo P. Le Bron, Kerr-McGee Industries, Inc., Alaska; Roy K. Hautzinger. Baker Transworld, Canada; M. C. Womach, Kerr-McGee, Alaska; Marion C. Williams, Kuwait Oil Co., Ltd., Kuwait; and P. K. Ozinga, formerly with Shell in Venezuela. Seated, left to right, Hans G. Goethe, Deutsche Erdoel A.G., Germany; Sir Robert H. Hadow, British consul general; Maj. C. Mott-Radclyffe, member of Parliament, England; and R. T. Myers, United Overseas Petroleum Co., Ltd.

C. ROBERTS, JR.

C. R. Roberts, Jr., has been promoted to buyer for refinery requirements by Mid-Continent Petroleum Corp., succeeding **J. R. Stockton,** who has retired. Roberts has been with Mid-Continent since 1947 and in 1949 was named assistant buyer. Stockton joined the firm in 1925 and was named buyer 4 years later.

Paul Bearden has been named manager of the manufacturing department of Texas Gas Corp. and New Ulm Corp. with headquarters at the Winnie, Tex., plant. He formerly was assistant to the vice president in charge of engineering and joined the firm in June 1951.

Herbert Hoover, Jr., son of the former president, has been named as a special adviser on world-wide petroleum matters to Secretary of State John Foster Dulles. A consulting engineer, Hoover formerly headed United Geophysical Co., and in the past 15 years has been an adviser on technical and economic problems related to oil to various governments including Venezuela, Chile, Peru, Brazil, and Iran.

Jack Green, geologist, has joined The California Co. at Bismarck, N. D.

Max McCormick has resigned as senior geophysicist for Stanolind Oil & Gas Co., at Bismarck, N. D.

John Sparks has been transferred by the Hunt Oil Co. from Mandan, N. D., to Minot, N. D.

Mathew Tudor, geologist for Sun Oil Co., has been transferred from Sidney, Neb., to Bismarck, N. D.

Roy M. Bauer, Jr., has been promoted by Stanolind Oil & Gas Co. from a junior petroleum engineer at Midland, Tex., to a petroleum engineer at Roswell, N. M.

C. Kimball Ham, geologist, has joined William Ross Cabeen & Associates at Los Angeles. He replaces **Dr. Burdette Ogle,** who was recently transferred to Denver as Rocky Mountain district geologist.

Gerald Burgess has been named district production superintendent for Ohio Oil Co.'s new district office at Cody, Wyo. Other Ohio personnel moved to Cody include **Lee Mathews,** district engineer; **Ray Bietman,** district geologist; **R. L. McGirr,** district drilling foreman, and **W. R. Kahla,** reservoir engineer. The Cody office will handle exploration, drilling production, and engineering operations in the area. It is

PERSONALS

Desk and Derrick Members Elect New Officers

New officers of the Association of Desk and Derrick Clubs of North America are shown following their election at the organization's second annual convention in Denver. Seated, left to right, are: Lorene Porter, San Antonio, secretary; Meitzie A. Palmer, Vander Leck & Whealton, consultants, Los Angeles, first vice president; Irene Stimson Cox, Panhandle Producing Co., San Antonio, president; Sybil Sureck, Union Oil Co. of Oklahoma, Oklahoma City, second vice president; and Angela Cross, Big Lake Oil Co., Pittsburgh, treasurer. Directors shown are: Standing, left to right, Bea Freyou, Esso Standard Oil Co., Baton Rouge, La.; Lydia Babka, Honolulu Oil Corp., San Francisco; Betty Heaton, American Leduc Petroleums, Ltd., Edmonton, Alta.; Elinore McAdams, Coastal Oil Co., Newark, N. J.; Eloise Norris, Dooley Engineering Co., Oklahoma City; Dorothy Kassell, Kobe, Inc., Fort Worth; and Minetta Miller, Ernest S. Baker, Denver.

a consolidation of all field offices in the area and replaces the district office formerly at Lovell, Wyo.

C. B. Folsom, Socorro, N. M., has been appointed chief petroleum engineer for the North Dakota Geological Survey.

Barton A. Myers, independent oil producer and consultant, and **Robert W. Wire,** president of Loffland Bros. Co., have been elected to the University of Tulsa's board of trustees. Wire is former chairman of the university's advisory council.

Walter R. Evans has resigned as chief reservoir engineer for Phillips Petroleum Co. at Bartlesville, Okla., to become a jobber with the company at Winter Haven, Fla.

Daniel Tabachnick, junior petroleum engineer, has been transferred by Sinclair Oil & Gas Co. from Nowata, Okla., to Bairoil, Wyo.

Harold F. Parsons has been appointed assistant manager of Tide Water Associated Oil Co.'s transportation and supply department. He is also manager of the New York crude and products section of the company's eastern division.

Robert M. Lowe has been transferred by Sohio Petroleum Co. at Oklahoma City, where he was an engineer, to Lafayette, La., as a senior engineer.

William Sanders, an engineer for Mene Grande Oil Co., has been transferred to the company's operations in eastern Venezuela after completing a year's assignment in the Caracas offices.

Troy C. Kadel, formerly assistant district superintendent for Sinclair Oil & Gas Co. at Eldorado, Tex., has been transferred to Fort Morgan, Colo.

J. F. Dobson, senior petroleum engineer, has been transferred by Sinclair Oil & Gas Co. from Ardmore, Okla., to Oklahoma City.

Roscoe C. Gillespie, formerly assistant district foreman for Sinclair Oil & Gas Co. at Sand Draw, Wyo., is now an intermediate petroleum engineer at Casper, Wyo.

Stephen Drake, intermediate petroleum engineer for Sinclair Oil & Gas Co., is now at Fort Morgan, Colo., having been transferred from Fort Worth.

H. O. Ruark, formerly division production superintendent for Shell Oil Co. at Oklahoma City, has been promoted to area production superintendent at Tulsa. He will be associated with **W. H. Collins,** general superintendent, who plans to retire at the end of this year. **O. L. Nuernberger,** who joined Shell in 1934, replaces Ruark at Oklahoma City. Ruark has been with Shell since 1922 and was appointed to his former position in 1948.

DEATHS

Edwin B. Reeser, 81-year-old pioneer oil man and president of Barnsdall Oil Co. from 1925 until his retirement in 1943, died September 12 in Tulsa. He entered the oil industry in 1891 with Standard Oil Co. (N. J.) at Oil City, Pa., and joined Barnsdall in 1904 after operating as an independent for 4 years. Reeser was one of the organizers of Great Lakes Pipe Line Co. and a pioneer in oil conservation efforts. He was elected president of American Petroleum Institute in 1928 and was named "Grand Old Man of Refining" at the 1953 International Petroleum Exposition.

Isaac Biddle, 82, died recently at Bristow, Okla. He was a retired district superintendent in the pipe-line department of Deep Rock Oil Corp. and had worked in the pipe-line industry for 50 years.

Daniel S. Keenan, 59-year-old president of Carnegie Natural Gas Co. and Apollo Gas Co., died recently at Pittsburgh. He had been president of the firms for 15 years and also was president of the Engineers Society of Western Pennsylvania. Keenan had also been with United Carbon Co.

C. O. Davis, 65, died unexpectedly recently at Mt. Pleasant, Mich., following a heart attack. He retired July 1 as Michigan superintendent of the Pure Transportation Co. He had been with the firm 30 years.

Elton Aubrey Prestridge, 42, died in Houston September 9. He had been with The Texas Co. for more than 15 years.

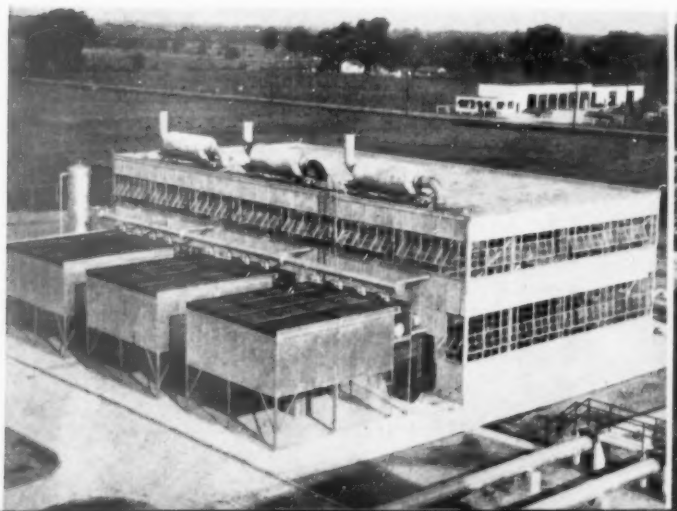
J. Harry Ibbotson, 62, died recently at Toronto, Canada. He had been associated with British American Oil Co., Ltd., for 30 years.

Thomas J. McLoughry, a mechanical engineer with Sinclair Refining Co. for 30 years before his retirement in 1950, died recently at Havertown, Pa.

Mike A. Ledford, 52-year-old president of Houston Drilling Co., died in Houston September 10.

THE JOURNAL REPORTS ON

PIPE LINING IN '53



View from launching site across Mackinac Straits to south shore where pulling winch is located.

Bird's-eye view of launching operations under way. Pipe passes over equalizing devices close to the shore near the control tower.

WORLD'S DEEPEST PIPE LAYING

Mackinac Straits Crossing Is 1953's Most

THE underwater crossing of Lakehead Pipe Line Co. at Mackinac Straits has involved the laying of two 20,000-ft., 20-in. lines, 1,250 ft. apart in water as deep as 240 ft. This is the deepest pipe laying ever attempted.

The crossing is a vital link in Lakehead's 644-mile, 30-in. crude-oil line being built this year from Superior, Wis., via Mackinac Straits to Sarnia, Ont. The project is an extension of the Interprovincial-Lakehead line built in 1950 from Edmonton, Alta., to Superior.

Engineering and management . . . Bechtel Corp. is directing the entire Superior-Sarnia project, as agent for Lakehead Pipe Line Co., a subsidiary of Interprovincial Pipe Line Co. Construction of the Mackinac Straits crossing has been contracted by Merritt, Chapman & Scott Corp., which rented launching, pontoon, and pulling equipment from Collins Construction Co. Welding and pipe protection application has been subcontracted by Midwestern Constructors, Inc.

Pulling . . . The first of the two 20,000-ft. lines was successfully pulled across the straits between 2:40 a.m., August 9, and 8:14 p.m., August 15.

Pulling was completed by a steam winch operated with a single drum which handled 1,250 ft. for a single pull. Cable changeovers between pulls took an hour. Between pulling of each of eight 2,500-ft. sections of pipe, the tiein welding was done in 4 to 4½ hours. The fastest tiein was made in 3½ hours. Moving of a 2,500-ft. section of pipe to the launching dollies took 45 to 50 minutes.

Early in the pulling operations, work was interrupted by the breaking of a shaft on a diesel-driven winch having two drums for handling a 1¾-in. two-part line. After operating for a while with one drum, the diesel unit was supplanted by a one-drum steam winch of 105,000-lb. capacity, operating with a two-part 1⅜-in. cable. This cable functioned with block and dead man. The block was attached to an equalizing beam connected to the 2-in. main cable which pulled the 20-in. pipe. The equalizing beam was suspended above the ground by two boom tractors.

A crane eased the pulling of cable fittings as they passed through the fairlead or guide near the shore.

Mandrels . . . Buoyant mandrels on the 2-in. pulling cable were so effective that there was no trouble from the cable digging into the lake bottom. Surveys showed that the underwater pipe line was unusually straight and deviated only a few feet from a direct route. The only time that a diver was sent down to check the line's position was when the front end was approaching the vicinity of a survey tower, which might have been damaged if the line was off its course in that direction.

Laying operations for the second line were scheduled as this article was going to press.

Planning operations . . . To minimize the hazards of such a long, deep crossing the followng important provisions were made:

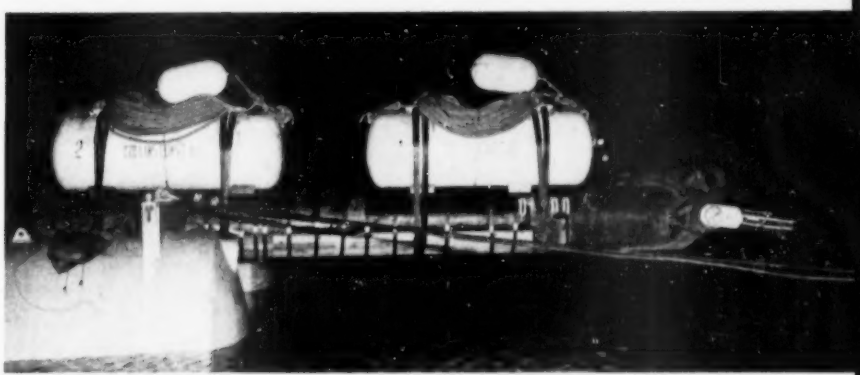
1. Pipe of unusual ductility with 13/16-in. wall has been furnished which is sufficiently heavy to obviate the need for additional weighting material for ballasting purposes.
2. Low negative buoyancy for both pulling cable and pipe was given by buoyant mandrels and pontoons.
3. Facilities were provided for pulling the cable upward in case it buried itself in the bottom.

In addition to applying successful modern techniques, the engineers developed new procedures which promise

Here are the details of one of the most interesting underwater crossings in the history of pipe lining. It involves the pulling of two 20,000-ft. lines, 20 in. in diameter, across the straits between two capes in the area where Lake Huron and Lake Michigan join. At some points the pipe was laid in 240 ft. of water, deepest pipe laying ever attempted. The crossing is on Lakehead Pipe Line Co.'s 664-mile line from Superior, Wis., to Sarnia, Ont.

by Paul Reed

First 2,500-ft. section with pontoons attached, mounted on rubber-tired dollies, ready for launching.



Beginning of launching of first section of western line at 2:40 a.m., August 9. After completion of laying, a light rope along the pipe tripped the small buoys which pulled 1-in. rope to the surface for operating devices for releasing the large pontoons.

Launchway control tower and control survey platform during preparations for pulling.

Challenging

to have a far-reaching influence on future underwater pipe-line projects.

Information presented in this article was obtained by the author during a trip to the construction work at Mackinac Straits and to the Bechtel office at Saginaw.

Crossing plan . . . The main features of the plan for the crossing were effectively summarized in a statement of decisions at a conference of the technical committee and the contractor on May 29 as follows:

1. Adequate precautions would be taken during launching operations to assure accurate placing of the line with the least possible danger of overstressing the pipe.
2. Accurate control would be maintained so that the bottom location of the pipe line could be determined at all times.
3. Velocity readings would be taken continuously at the bottom prior to launching.

The committee approved a plan for pulling the two lines by means of cables to winches on both sides of the straits which would have the following features:

1. Dynamometers would indicate the amount of tension in the line in order

Front end of first section being swung into position on equalizing devices to prevent plunging of pipe. Equalizer is pivoted for teetering motion.

Buoyant mandrel of type connected at regular intervals to the 2-in. pulling cable for reducing drag on the bottom of the straits.

Heavy gouging mandrel coming out of the water immediately ahead of the pipe at completion of pulling the first 20-in. line across the straits.

that the amount of "pull" be kept well below the allowable tensile strength of the pulling cable and the pipe.

2. Pontoons would be attached to the pipe spaced at intervals to provide negative buoyancy of approximately 6 lb. per lineal feet.

3. The pipe would be pulled in 2,500-ft. sections with tiein weld made approximately at the water's edge.

4. Tension would be maintained on the completed line until filling had begun. The tension would be gradually released to allow the filled pipe to settle into position, eliminating the probability of lateral shifting of the line if allowed to settle in an empty condition.

5. Lifting lugs would be attached to the forward end of the line with cables extending to the water surface where they could be picked up by a derrick for lifting the line "free" if it became entrenched in the bottom.

The committee approved a minimum radius of curvative of 1,700 ft. for the laying of the line except in extreme cases.

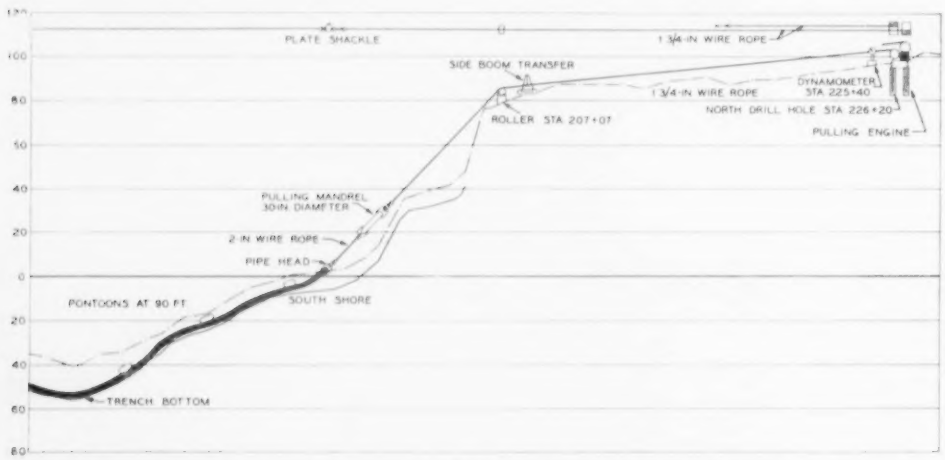
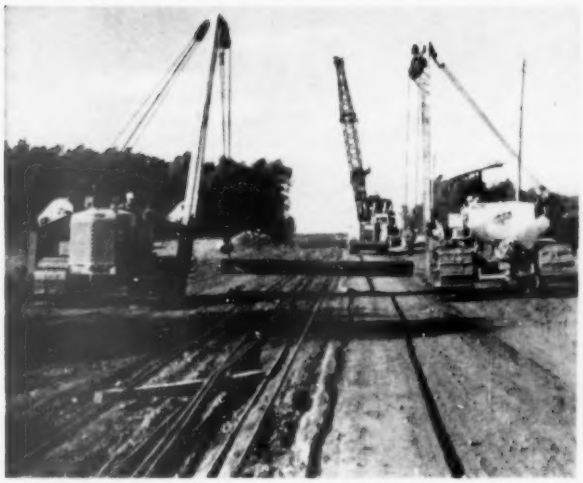


Diagram of pipe and cable during pulling operation. Detail shows pipe with pontoons attached to decrease negative buoyancy. A heavy pulling mandrel for gouging precedes the pipe.



Side-boom tractors (left) supporting pulling-cable equalizer-beam on the south shore. Closer view of equalizer beam at right shows $1^{3}/_{8}$-in. cable from deadman running through sheave to pulling winch. Main 2-in. cable extends from other side of beam to front end of pipe.

Where bottom preparation was necessary in the deep area, the contractor decided to cut through the humps, wherever possible, rather than to fill the low spots.

The straits crossing traverses 20,000 ft. of water between two capes in the area where Lake Huron and Lake Michigan join. The launching area was located at Point LaBarbe on the north side near St. Ignace, Mich., and the lines were pulled toward the manifold on the south shore at McGulpin Point near Mackinaw City, Mich. The west line would be laid first. Then equipment would be moved to lay the second line, 1,250 ft. eastward.

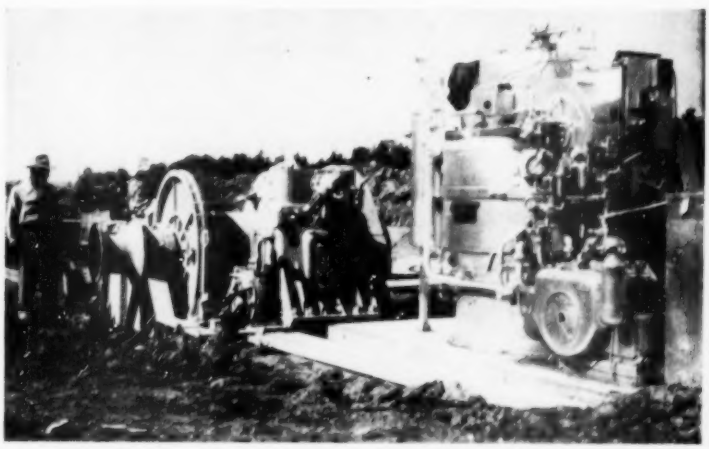
Survey and Data

As a first step in preparing for the laying of the two 20-in. lines at Mackinac Straits between Lake Huron and Lake Michigan, a survey was made to determine the contours of the lake

(Continued on page 310)

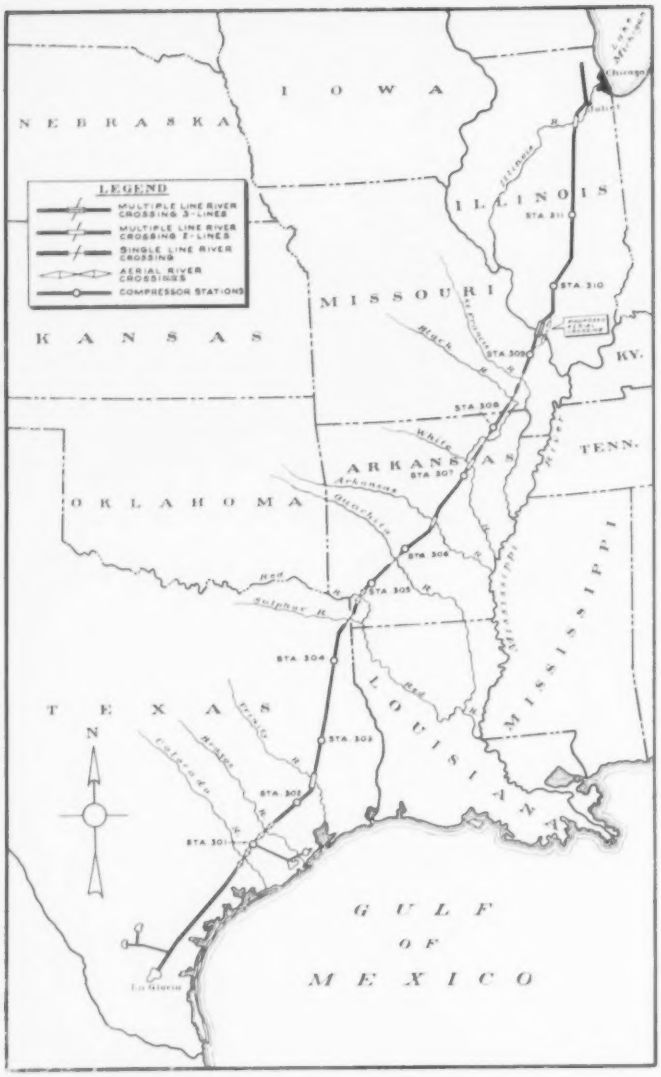
Engineers determined position of pipe on the bottom by fathometer in a launch equipped for sonic survey.

Crane easing pulling cable fittings as they came over the fairlead or guiding device at south shore. Pulling cable is connected to the equalizer beam.



Tension on the pipe was maintained by a 50-ton back hold winch operated by a new type of boiler and 165-hp. steam engine located at rear of operations on the north shore. The steam pulling unit on the south shore was of the same type.

The suspension bridge crossing of the Brazos River in Texas. The pipe line across the bridge is 30 in. in diameter.



A map of the Texas Illinois Natural Gas pipe-line system showing the important river and stream crossings. The line is 30 in. in diameter from Station 301, Hungerford, Tex., to the meter station at Joliet, Ill.

by David C. Palm

Planning for Assured Service of

Gas-Transmission Lines Across Rivers

Modern tools aid in selecting best route but good judgment also carries big load

THE crossing of streams and rivers by the pipe line is one of the major problems of gas transmission. In the design and construction of the long-distance 30-in. gas line of Texas Illinois Natural Gas Pipeline Co., the problem of selecting the safest and most economical point for crossing the water courses confronted the engineers.

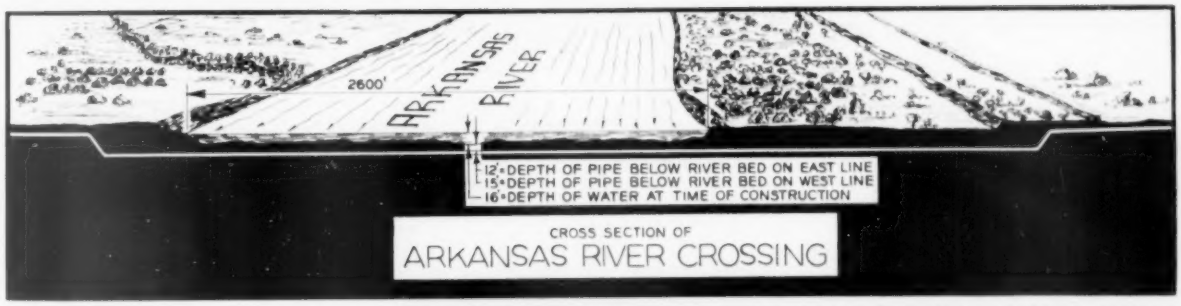
In building the crossings for the Texas Illinois line, the experience gained from years of operation of its affiliate, the Natural Gas Pipeline Co. of America, was highly important.

Reconnaissance work has been immeasurably simplified by the use of observation planes and the development of aerial surveys. Yet, in the final analysis, these modern tools are limited in value as aids in confirming that the best routing for a pipe line has been selected. The engineers must avail themselves of the most favorable location for such important segments as stream crossings when all of the design factors are balanced. From this point on they must design and construct the facility so that it is an integral part of the pipe-line system and will function in assured continual service.

Flood Conditions

The design of river crossings calls for a thorough understanding of the tremendous forces exerted by sweeping flood waters. To minimize these invites disaster. The long list of failures of submerged crossings on major streams is evidence of the seriousness of the problem. Historical data, available on a particular stream, will give an indication of scouring conditions, bank recessions and changes, and other contributing factors which tend to expose a line in a stream bed or in extreme cases result in a complete washout.

Effect of turbulence . . . During flood conditions with resultant high turbulence, the density of the muddy or silt-laden water is higher than that of


2600'
ARKANSAS RIVER
12'-DEPTH OF PIPE BELOW RIVER BED ON EAST LINE
15'-DEPTH OF PIPE BELOW RIVER BED ON WEST LINE
16'-DEPTH OF WATER AT TIME OF CONSTRUCTION
CROSS SECTION OF
ARKANSAS RIVER CROSSING

An aerial view and cross-section of the underwater crossing of the Arkansas River with two 24-in.-diameter pipe lines.

clear water. Suspended material is heaviest in the deepest part of the channel where the velocity is the greatest. Furthermore, turbulence and eddies at the bottom of the stream will vary and tend to increase the silt load. Thus an exposed section of a pipe line in a stream bed during a flood is subjected to the impact and vibrations caused by the rush of a fluid whose density is greater than that of water. Thus the hazard of exposed pipe is increased under these conditions.

The pipe-line engineers responsible for constructing a river crossing must anticipate all of the factors that tend to weaken the facility or cause it to fail and design the structure accordingly. Remedial work can overcome weaknesses that develop as a result of bank erosion or shifts in the banks. Maintenance of the piping in major river crossings, however, once they are constructed is largely a misnomer. Pipe lines in such streams are often rebuilt, but seldom repaired. If a disastrous flood should disrupt pipe-line service across a major river, it is impossible for the men charged with pipe-line maintenance and operation to meet nature on her own terms and win against the tremendous odds they face. Any kind of repairs under these circumstances can only wait until flood waters have receded. Thus the insurance against interruption of service as a result of crossing failure must, to a great extent, be built into the project.

Three types of crossings . . . In designing the crossings for the Texas Illinois line, three types of river crossings were used: (1) multiple-line submerged crossings, (2) heavy-wall single-line submerged crossings, and (3) suspended crossings.

All of the stream crossings on the Texas Illinois system which lie below the Mississippi River are tributaries of that river or drain directly into the Gulf of Mexico. The pipe-line crossing is in the lower reaches of these streams near their mouths. The only river crossing of importance north of the Mississippi is the Illinois River. The other streams crossed by the pipe line in the State of Illinois are located on the divide between the drainage to the Illinois and Ohio rivers with the result that they do not have large watersheds.

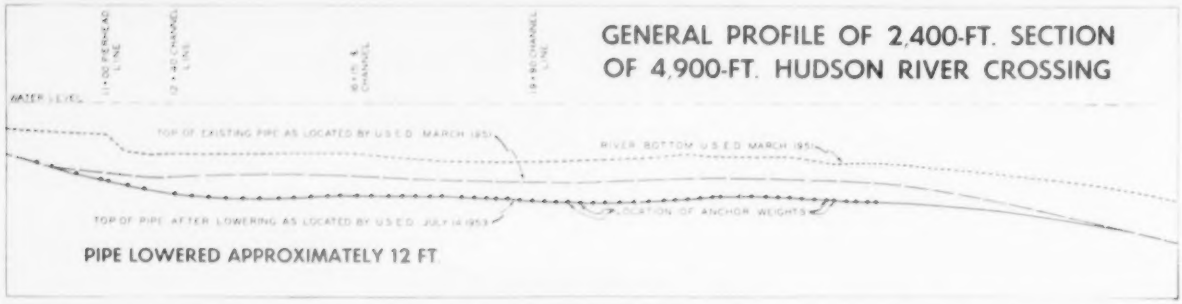
Multiple lines . . . The submerged multiple-line crossing was used on five major rivers, the Trinity, Arkansas, White, Mississippi, and Illinois. At the Mississippi River, three 20-in. lines were laid across the channel. The remainder of these crossings were laid using two 24-in. lines between headers. In all cases the lines were laid in a straight line across the channels.

Multiwrap . . . The pipe used on the two line crossings was multiwrap consisting of ½-in. wall wrapped with two layers of ¼-in. resulting in a total wall thickness of 1 in. The resulting pipe weight was sufficient to overcome buoyancy without the use of supplemental

(Continued on page 319)

THE AUTHOR

David C. Palm is general superintendent of pipe lines of Natural Gas Pipeline Co. of America and Texas Illinois Natural Gas Pipeline Co. He is a graduate of Stanford University, and began his career in the petroleum and natural-gas industries in engineering and supervisory work with the Cities Service organization. He has been in the employ of Natural Gas Pipeline in various capacities since the company was organized. He has served as construction engineer, district and division superintendent, and superintendent of pipe lines. He was advanced to his present position in 1952.



Pierhead Line and Channel line refer to east and west channel limits, stationing being taken from profile drawing. Pierhead Line is that boundary beyond which U. S. Army Engineers do not allow pier construction.

Special Jet "Trencher" Used to Lower Hudson River Crossing

Transco's gas line buried additional 12 ft. at 134th Street, New York

Specially designed Collins submarine pipe-line trencher used in lowering Transco's Hudson River crossing approximately 12 ft. at 134th Street in New York City. This patented trencher uses the jetting principle. As photo was taken they had 120 psi. pressure on them.

by I. W. Dods*

AFTER 102 days of work, Transcontinental Gas Pipe Line Corp.'s Hudson River crossing at 134th Street in New York City was lowered an additional 12 ft. on July 11, for a distance of 2,400 ft., by jetting with a specially designed "trencher." Gas service went on through the line uninterrupted during the lowering operation.

The line had to be lowered because U. S. Army Engineers desired to deepen the Weehawken channel in the area of the company's pipe line. The original crossing had been laid in 1950. Pipe is 26-in. o.d., with a wall thickness of 1⅛-in., and ⅝-in. Somastic coating, covered with wooden slats as a protection during initial pulling operations. The pipe lay 12 to 14 ft. below the bottom of the Hudson River, buried by natural backfill of silt and sandy clay.

Various methods considered . . . A number of methods for lowering the line were discussed, and the jetting operation was decided on. Sammy Collins, president of Collins Construction Co., had successfully lowered 12 miles of Transco's pipe line across West White Lake in Louisiana by use of an underwater trencher. A larger trencher was designed by Collins for the Hudson River job, patterned after the small version used on West White Lake. He also designed a roller weight which could be placed on the pipe in shallow water, and rolled along the line into deep water. This enabled divers to work in shallow water where they were not affected by the tides.

Equipment . . . Equipment for the lowering operation was assembled during March, and by April 1, actual lowering work started. The marine equipment and labor were contracted by Gates Brothers, Inc., of Little Ferry, N. J. Two 320-hp. three-stage pumps, each rated at 1,000 g.p.m. at 230 psi., were installed on a 30 by 90-ft. barge, along with two 315-cu. ft. per minute air compressors. The pumps were manifolded into a 10-in. header ending in two 4-in. connections. The air compressors were manifolded into a 3-in. header.

The barge was equipped with deck winches for handling anchor cables for

*Senior pipe-line engineer, Transcontinental Gas Pipe Line Corp., Houston.

Equipment barge at work in midstream on Hudson. Large tanks at stern carried enough fuel for 48 hours' continuous running. All motors were fueled by piping to reduce the fire hazard.

Anchor weight ready to be lowered. Diver is standing by to latch 2-in. bar under the pipe. Black bands on rollers are polyvinyl tape.

controlling the position of the barge on the water. Another 30 by 90-ft. barge carried a ¾-yd. crane which was used to handle the anchor weights and the probing bar.

Trencher used . . . The trencher was put on the line near the New Jersey shore, in approximately 20 ft. of water. The pipe was buried in 14 ft. of mud which the trencher had to cut through until it reached the pipe. Then a diver was sent down to latch the trencher onto the pipe. Once the trencher was on the pipe, pumps and compressors were opened up to full capacity, delivering water at 2,000 g.p.m. at 230 psi., and air at 630 cu. ft. per minute at approximately 50 psi.

Slow progress . . . Progress was slow because of the heavy overburden. Fathometer cross-sections of the ditch showed that 50 to 60 cu. yd. of material was removed for every lineal foot of progress along the pipe. The first 700 ft. of material near the New Jersey shore was very soupy and ran continuously. Progress was only about 25 ft. in 8 hours. Trenching continued with the thought that perhaps the material would soon stand up better.

To improve progress, two 500-g.p.m. pumps were added to the equipment barge. These were manifolded together to a device called a "horn." The horn was attached to the front of the trencher at an angle of 45° from vertical. This horn was designed to help cut the overburden that piled up in front of the trencher. Water was pumped to the horn at the rate of 1,000 g.p.m. at 160 psi.

One of the 315-cu. ft. per minute air compressors was replaced with a 600-cu. ft. per minute model which gave 915 cu. ft. per minute of air. With these changes, progress picked up and 60 ft. was made in 8 hours. However, this method was not economical, and other methods had to be found.

Stop order issued . . . On May 11, R. H. Crowe, chief engineer of Transco, ordered the trenching operation stopped. A dredge was then brought in to help remove the thick overburden. This dredge, the Maryland, of Arundel Corp., came on the site and dredging was commenced on a 24-hour basis. The bucket on the Maryland had a 10-cu. yd. capacity and weighed 23 tons, empty. Dropping this bucket near the pipe required the knowledge of the exact location at all times. For this reason, additional Transco engineers were required for the job.

Lem Sharpe, of the Houston office; and Stan Smith, Walt MacKinley, and Charlie Beanco, of the Newark office, all had an important part in seeing that the bucket of the dredge did not hit the pipe. Buck Germany, of Houston, office manager, handled all the administrative details.

Arundel installed a fan-marker system, giving east and west control over the pipe line and a range system was installed to give north and south control. Fan marker and ranges were lighted at night with mercury-vapor lights, visible in all weather except during an extra-heavy fog.

Dredging operations . . . The dredging program was carried out on a 24-hour basis, 6 days a week. A ditch was dug

(Continued on page 306)

On the job site are, left to right: Bob Gates, president, Gates Brothers, Inc.; I. W. Dods, Transco engineer; Jean Johnson, superintendent for Collins Construction Co.; Sammy Collins, president of Collins Construction; and R. H. Crowe, chief engineer for Transco.

Drilling machine at left is operating for installation of well points for dewatering at beginning of Arkansas River crossing.

Sinclair Crude Line Crosses 31 Streams

Five major rivers were crossed, the crossings being built of electric-weld pipe with ½-in. wall. Pipe was double-coated with protective wrappings and rock shield

by J. D. McConnell

ON the route of the 670-mile crude-oil line from Cushing to Chicago built in 1952 and 1953, a variety of conditions were encountered at the water crossings. Altogether, 26 lesser streams and 5 major rivers were crossed. This article deals with the practices applied at the Arkansas, Cimarron, Missouri, Mississippi, and Illinois rivers.

The procedures have been adopted with the objective of obtaining sound, economical construction. Policies have been determined through consideration of modern techniques against a background of 50 years of company experience with the rivers in the area.

Before discussing what was done at the five major rivers individually, certain general policies in regard to all of them will be summarized.

1. The company has a policy of burying lines deeper than was customary for pipe lining in former years.

2. Pipe was laid with upstream bow at the Cimarron, Arkansas, and Missouri rivers, which are swift and turbulent during flood time. The upstream bow, widely used by the industry for a long time, has the advantage of subjecting pipe to compression, which tends to force the line down deeper in the river bed.

3. Sags are located well back into the banks wherever there is a possibility of the stream changing its course. Even on small streams the company sets sags well back into the banks to insure against exposure if banks erode.

4. All five major water crossings were built of electric weld pipe with ½-in. wall. Welding was done with a minimum of four beads. X-ray inspection was applied at all welds.

Protection was given by a double coating of coal-tar enamel, wrapped with fiber glass, kraft paper, and ¾-in. rock shield. Wood slats covered the pipe between the river clamps which were applied on top of the rock shield.

5. While much care was given to adequate protection of the pipe by coating and wrapping, much reliance is placed on the effectiveness of cathodic protection by the appropriate installation of magnesium anodes and rectifiers.

6. During construction of the Cushing-Chicago line, the practices in regard to river clamps were modified to achieve greater effectiveness. By using lighter clamps which were more closely spaced, the submerged line is more flexible and there is less danger from the clamp pulling on the pipe.

This change was accomplished by discontinuing the use of clamps weighing 5,373 lb. per set, which were spaced at 20-ft. centers on 24-in. crossings of the Arkansas and Cimarron rivers in the early part of construction.

Concrete river weights on 22-in. pipe preparatory to pulling sections across the Illinois River.

By the latter procedure, the 24-in. Missouri River crossing was laid with clamps of 2,180 lb. per set spaced at 6-ft., 8-in. centers. The 22-in. pipe at the Mississippi and Illinois rivers has 2,410-lb. clamps also spaced at 6-ft., 8-in. centers.

7. Testing of the Mississippi and Cimarron crossings was done at 1,000 psi. after the river crossing was completed. At the Mississippi the line was laid from a ramp barge. At the Cimarron pipe was laid in a dewatered ditch. The other three crossings were laid by the pulling of long sections of pipe. Prior to pulling, each section was tested at 1,000 psi.

The Cimarron River has a 2,000-ft. span, including the 850-ft. section at the river. Upstream bow was 120 ft. The line was laid by the dewatering method in order to install the pipe so that damage to coating could be avoided.

At the Arkansas River the total span of 1,800 ft. includes a river section of 1,200 ft. The upstream bow is 100 ft. In laying this crossing, 1,400 ft. was pulled in one section.

The Missouri River was crossed by 1,400 ft. of 24-in. pipe laid with a 90-ft. upstream bow.

A trench was shot through 400 ft. of rock on the south side. To meet U. S. Engineers' requirements, the line was laid 18 ft. below mean standard low water level.

At the north bank trenching went 400 ft. into the bank. Trenching was done to the same depth as the stream crossing. Excavating work begun by dragline was completed by dredge.

Tractor and crane handling pipe at completion of last pull across the Illinois River.

The Mississippi River crossing of 7,200 ft. included pipe for traversing the levees on both sides of the river.

The overland route of the main line was slightly deviated to take advantage of the existing favorable conditions for placing the pipe in the quiet waters above the dam in the vicinity of Quincy, Ill. Pipe was laid 18 ft. below the average level of the water behind the dam.

At the Mississippi levees the dike embankments were cut down from the top to provide for location of the pipe at a depth of 5 ft. below the ground level. On the east side levee height is 17 ft.; on the west side, 12 ft.

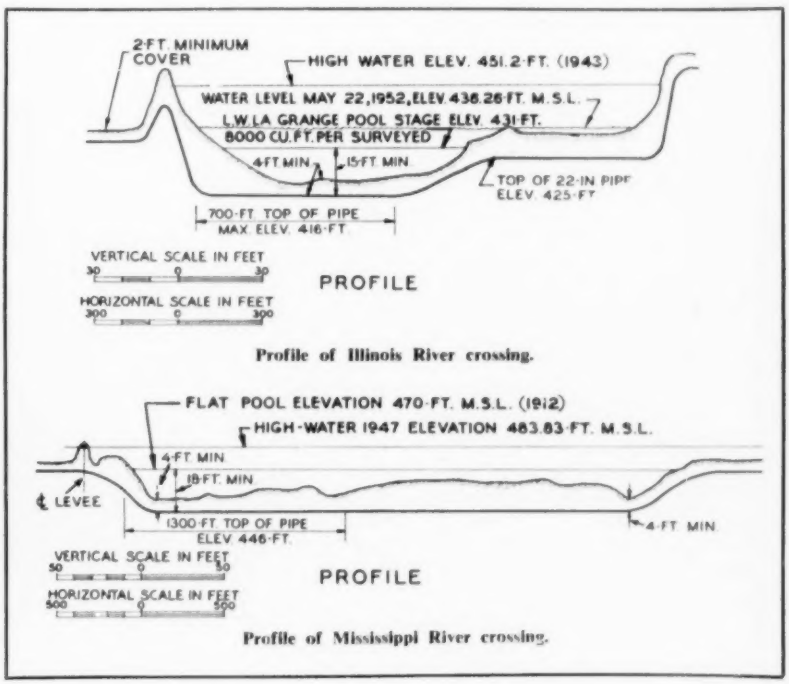
The 22-in. pipe line passed through a 26-in. casing at each levee. Casing was swedged down and welded to the 22-in. pipe. Insulators were installed in the casing. "Seepage rings," which are 6-ft.-sq. steel baffle plates, were welded to the casing to stop the boring of rodents along the pipe. To meet the requirements of the U. S. Engineers in installing these baffle plates it was necessary to open the dikes rather than bore through them for installation of the line.

For the Mississippi River crossing pipe was laid from a ramp barge where 80-ft. lengths were welded to the line and launched.

Double jointing of 40-ft. joints to

(Continued on page 272)

Later stage in dewatering the trench at the Arkansas River. A sudden rise in water level of the river made it necessary to discontinue dewatering after going 200 ft. The remainder of the crossing was pulled through the river.


2-FT. MINIMUM COVER
HIGH WATER ELEV. 451.2-FT. (1943)
WATER LEVEL MAY 22,1952, ELEV. 436.26-FT. M.S.L.
L.W. LA GRANGE POOL STAGE ELEV. 431-FT.
8000 CU.FT. PER SURVEYED
4-FT. MIN.
15-FT. MIN.
TOP OF 22-IN PIPE ELEV. 425-FT.
700-FT. TOP OF PIPE MAX. ELEV. 416-FT.
VERTICAL SCALE IN FEET
30 0 30
HORIZONTAL SCALE IN FEET
300 0 300
PROFILE

Profile of Illinois River crossing.

Profile of Mississippi River crossing.

Typical delivery terminal on Plantation Pipe Line system at Moundsville, Ala. Piping is designed so that product travels the same distance, in going through parallel filter and meter batteries, in order to minimize commingling.

How to Size Tank-Farm and Delivery Lines

. . . at products pipe-line and marine terminals

Determination of line sizes can be made simply and rapidly with the aid of the charts given here for the modified Hazen-Williams formula.

by Edwin A. Birge

DURING the past several years, products-pipe-line design and operation have undergone considerable change. The successful operation of large-diameter products lines, without excessive commingling of products, has greatly accelerated the growth of the industry. The trend is toward larger-diameter lines, with high throughput rates, and these lines are usually designed so that intermediate stations can be installed to increase the throughput of the line as requirements increase.

The same thing is true of marine terminals. The size of tankers is being increased continually, and the delivery rates from tankers must be increased to avoid excessive unloading time. Offshore, underwater pipe lines have offered a solution to those marine terminals which lack deep-water harbors. From an economics standpoint, it is desirable to lay a line, in many instances, in order to enable larger tankers to come into these terminals.

The trend toward larger pipe lines and tankers, with attendant large increases in delivery rates, makes it necessary to design with care the delivery lines, from the pipe-line terminal or from the ship, to the tank-farm manifold, and the lines from the tank-farm manifold to the tanks. Careful initial design will avoid possibility of having to increase the size of these lines when the delivery rate is increased.

In the past, the tendency has been to build these lines too small. This has been due to the high cost of large-diameter valves and fittings; and, probably, to a lack of complete understanding, by the receiving companies, of the ultimate capacity of the delivering facilities.

In the following, the important factors which influence the design of delivery lines are listed, and a relatively simple method of determining the right size for such lines is given.

CONTROLLING FACTORS

The important factors which control the sizing of delivery and tank lines can be listed as follows:

1. The maximum pressure which can be "backed up" against the pipe-line terminal, or the pressure available at ship's pumps.
2. The maximum rate at which the pipe line is **designed** to deliver products.
3. The desired pumping rate from ship to shore, for minimum lay time.
4. Distance and difference in elevation between pipe-line delivery terminal, or ship's pumps, and receiving tanks.
5. Physical properties of product to be pumped.
6. Economics of delivery line and manifold construction.

The **maximum pressure which can be backed up against the pipe-line terminal** is the pressure which is available to overcome friction and elevation differences between the pipe-line terminal and the tanks. It is usually around 45 psi., including tank head. This maximum is set by the design of the pipe-line terminal.

A typical products pipe-line delivery terminal is shown in the photo. A schematic design of the same terminal is given in the isometric diagram. Strainers, meters, valves, and other fittings downstream of the pressure-reducing valve usually are Series 15, 150-psi. fittings.

The pressure-reducing control valve is designed to be fully closed when the downstream pressure reaches 150 psi. This valve, however, begins to close, partially, at a downstream pressure of around 75 psi. If the pressure builds up above 75 psi., the valve pinches the flow, and the delivery rate is restricted. This has the effect of slowing down the entire line as pressure is backed up against it.

Pressure drop . . . There is a considerable drop in pressure across the strainers and meters of the delivery terminal. If the terminal is properly designed, and the straining media are clean, this pressure drop should not exceed 15 to 20 psi. However, it is necessary to provide some cushion against the build-

THE AUTHOR

Edwin A. Birge, eastern division superintendent, Plantation Pipe Line Co., started in the oil industry with Oklahoma Pipe Line Co. where he spent 10 years in all phases of operations serving as dispatcher, district foreman's clerk, and general superintendent's clerk. During this period he studied petroleum engineering at University of Tulsa. Birge transferred from Oklahoma Pipe Line Co. to Plantation on January 1, 1942, as chief dispatcher. He held this position until January 1, 1947, when he was promoted to his present post.

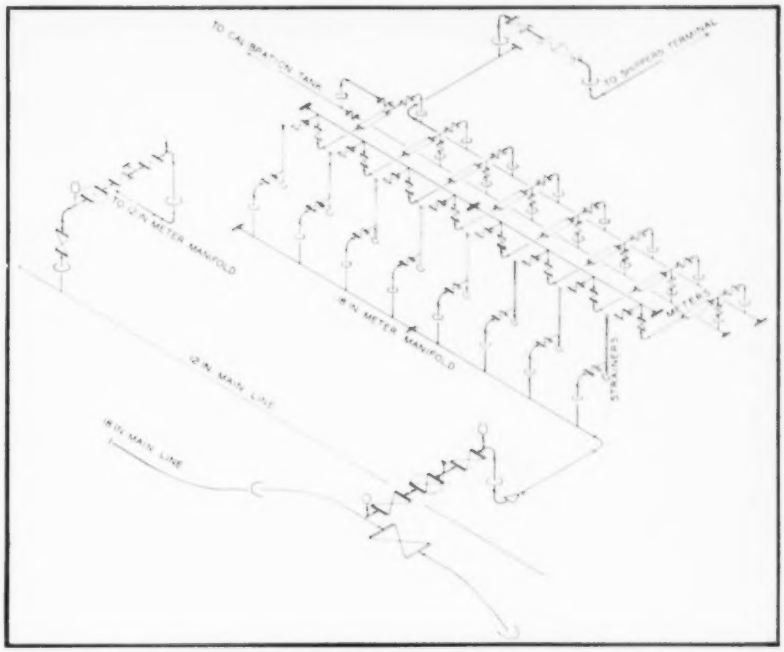
ing up of pressure across the strainers as they accumulate impurities from the stream. Experience on Plantation pipe line has indicated that around 30 psi. must be provided for the drop across terminal facilities in order to avoid frequent restrictions to the delivery rate.

Tank lines . . . In designing tank lines and delivery lines, the receiving company should take into consideration the maximum rate at which the pipe line is **designed** to deliver. In practically all instances, the pipe line is designed so intermediate stations can be added to increase the throughput. Unless delivery lines and tank lines are designed to handle the maximum throughput for which the pipe line is designed, it might be necessary to enlarge them at considerable additional expense when the pipe-line pumping capacity is increased.

Marine terminals . . . At marine unloading terminals it is again important that lines be adequate to handle the maximum rate which will be required to unload within the desired time the largest ships or barges, which will discharge at the terminal. At the high pumping rates usually required at marine terminals, short runs of small-diameter pipe between the tank-farm manifold and the tanks can seriously restrict delivery rates.

Differences in elevation between the pipe-line delivery terminals or ships and the receiving tanks either reduce or increase the pressure available for overcoming friction in the lines. These differences in elevation are important since the amount of pressure available is relatively small. On 0.73 specific gravity gasoline, the 45 psi. allowed at pipe-line terminals is equivalent to only 143 ft. of head.

From an economic standpoint, it is desirable to build the delivery lines and tank lines as small as practicable due to the high cost of large-diameter pipe and fittings. In the following, a method for sizing delivery lines, which considers all the above factors, is developed.



Isometric diagram, typical terminal product piping.

DEVELOPMENT OF FORMULAS

Most pipe-line engineers, who have flow problems involving heavy, high-viscosity fluids, use the Chezy or Fanning formula, or variations of them, in their design calculations. However, on products pipe lines, wherein the heaviest, most viscous product handled is No. 2 diesel fuel, the Hazen-Williams formula, modified for pipe-line use by the Great Lakes Pipe Line engineering department, is in popular favor. This formula lends itself readily to solution by the means of simple mathematics and charts. The chief difference between the Hazen-Williams formula and the others is that the Hazen-Williams formula does not take into account the viscosity of the fluid.

Select C Factor

Experience in the operation of Plantation pipe line indicates that simply selecting a C factor, where necessary, which adjusts for the more viscous fluid, is dependable and makes the calculations easy to handle. Therefore, the following equations are derived from the Hazen-Williams formula as modified by Great Lakes Pipe Line. This formula is:

$$C = \frac{162.04\, Q\, S^{0.54}}{P^{0.54}\, D^{2.63}} \qquad (1)$$

where:

Q = barrels per hour
P = pressure drop per mile (psi.)
S = specific gravity
D = internal diameter of pipe (in.)
C = roughness factor ("C" factor)

Solution of the above equation, mathematically, is rather involved. However, by solving the equation for P, it can be written in the following form:

$$P = S\,(162.04/D^{2.63})^{0.54} \times (Q/C)^{0.54}$$

For any given size of pipe and specific gravity of product, the term $S\,(162.04/D^{2.63})^{0.54}$ becomes a constant. By substituting K for the term, the equation becomes:

$$P = K\,(Q/C)^{0.54} = \text{pressure drop per mile (psi.)} \qquad (2)$$

Since these data are to be used only for products lines, it is useful to use 0.73 specific gravity (for gasoline) and plot the values of K for different sizes of pipe. Chart 1 shows the values of K for pipe sizes from 4-in. to 30-in.

Chart 2 is a conversion chart to reduce the ratio Q/C to $(Q/C)^{0.54}$.

Using Charts 1 and 2

By using the two charts, the calculation of the pressure drop through a given pipe size at a given throughput becomes very simple.

Example: Assume a 10-in. pipe, 25

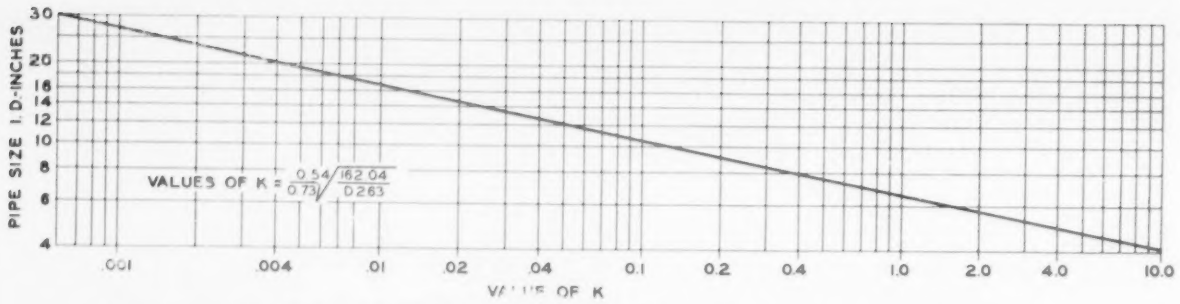


Chart 1—The "K" term in the modified Hazen-Williams formula can be determined rapidly from this chart.

miles in length, to operate at a rate of 3,000 bbl. per hour on gasoline. Use C = 140 for gasoline on new steel pipe:

$$P = K_{10^5} (3{,}000/140)^{0.54}$$

From Chart 1, $K_{10^5} = 0.12$.

The ratio 3,000/140 = 21.4, and, from Chart 2, $(21.4)^{0.54} = 290$.

Therefore:

$P = 0.12 \times 290 = 34.8$ psi. per mile

Total pressure drop, $P_t = 34.8 \times 25 = 870$ psi.

If the total pressure required to pump the given quantity through a given section of line is desired, provision must be made for the differences in elevation between the two points and the pressure needed at the end of the section.

System With Different Pipe Sizes

Usually there are flow charts available to all design engineers, which indicate the rates of flow through pipes. However, the foregoing was given to introduce the "K" factor. This factor will be used in the development of formulas for conditions which are not readily described on simple charts.

If it is desired to determine the quantity which can be pumped through a system containing different sizes of pipe, with a predetermined amount of available pressure, it can be done in the following manner:

Let EP = total effective pressure available to overcome friction in the system.
L_1 = length of one size of pipe (miles).
L_2 = length of other size of pipe (miles).
K_1 = K factor for pipe of L_1.
K_2 = K factor for pipe of L_2.

From Equation 2:

$$P = K (Q/C)^{0.54}$$

The total pressure drop in the first section of pipe would be:

(Continued on page 283)

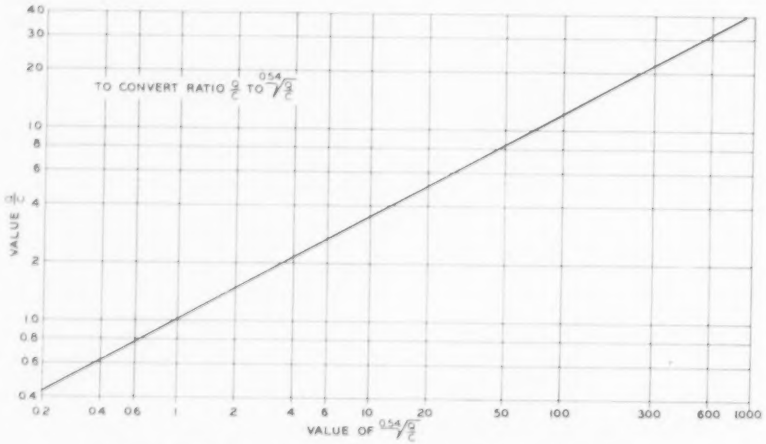
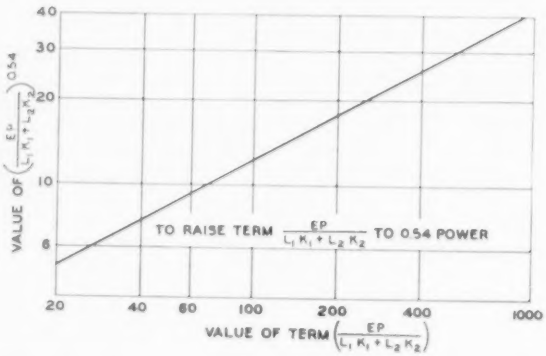


Chart 2—This chart makes it easy to obtain the value $(Q/C)^{0.54}$

Chart 3—In dealing with system containing different pipe sizes the EP (total effective pressure available to overcome friction) is involved, as well as length (L) and the "K" factor for each size of pipe.



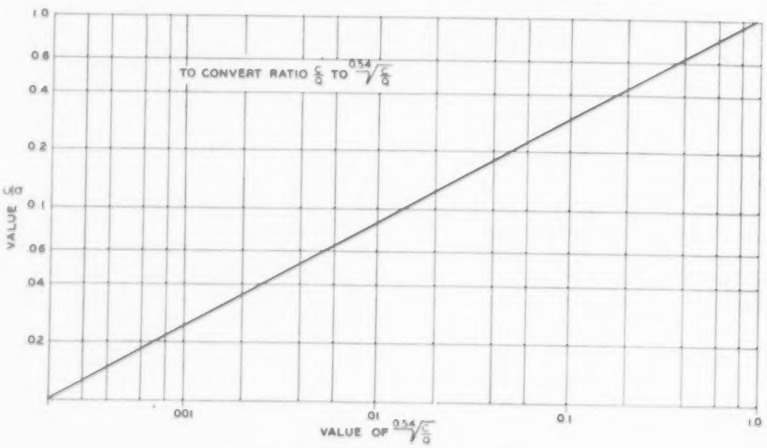


Chart 4—Obtaining values of $(C/Q)^{0.54}$

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Examples of perfect symmetry, the two 25,000-gal. Horton Watersphere shown in the accompanying illustrations are providing water under gravity pressure to meet domestic and industrial needs, plus a reserve for emergencies, at two of Shell's pipe line stations. The view at left shows a 25,000-gal. Watersphere at the station near Hominy, Okla., and the right view shows a similar installation at Cushing, Okla.

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Boscton, 10	1075 201 Devonshire St.	Houston, 2	2119 C & I Life Bldg.	San Francisco, 4	1554 200 Bush St.
Chicago, 4	2128 McCormick Bldg.	Los Angeles, 17	1523 General Petroleum Bldg.	Seattle, 1	1325 Henry Bldg.
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TROUBLE ISLAND

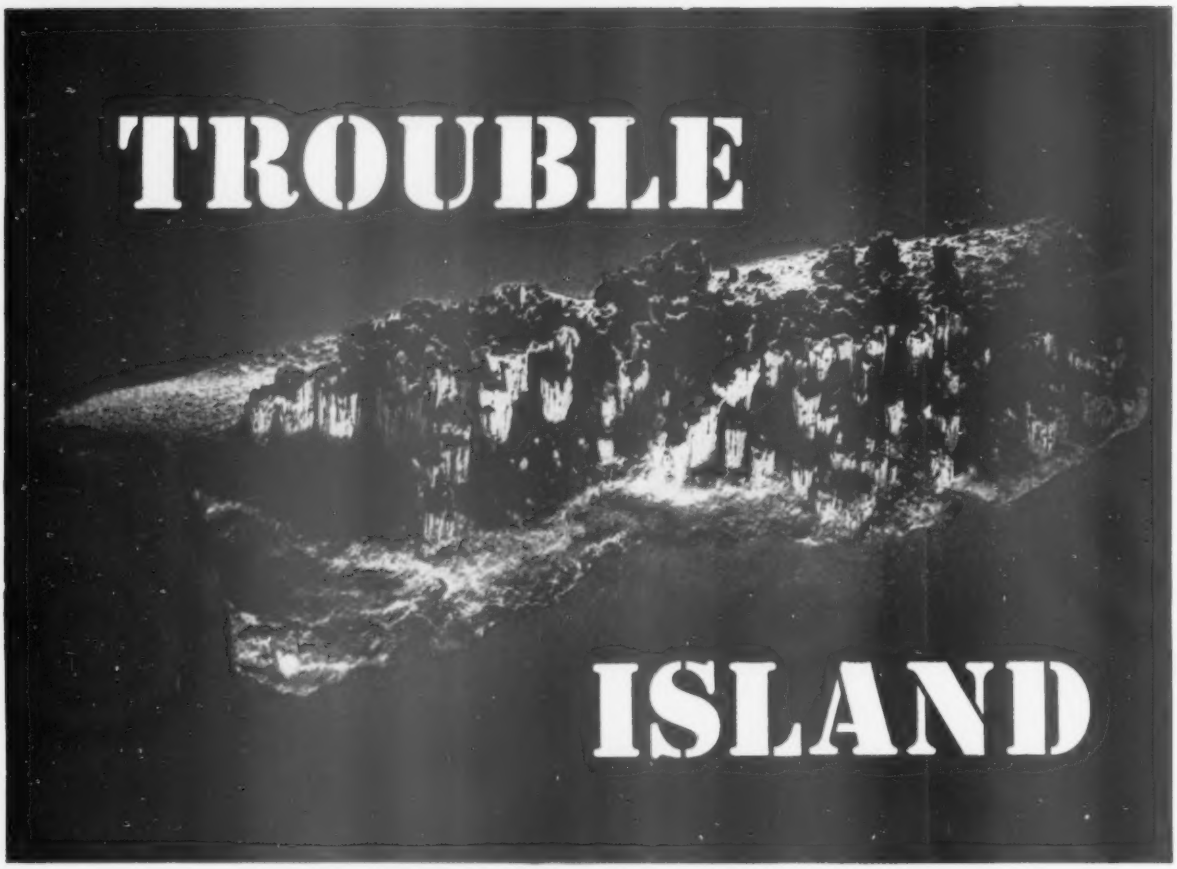

Photo is of a condenser-tube scale sample, about eight inches long. Solid scale is approximately ¼-inch thick, with "spires" ranging up to ⅜-inch height.

FIFTEEN years ago, this small island of trouble was part of a much larger open-box condenser problem at a refinery. Cooling water, running over 200°F. at outlet, contained 30 grains per gallon hardness and 20 parts per million iron. Tubes scaled heavily and rapidly without chemical inhibitor. Even with the best inhibitor then known, results were as illustrated above: partial inhibiting action creating the "spires" or forest-like deposits on tubes.

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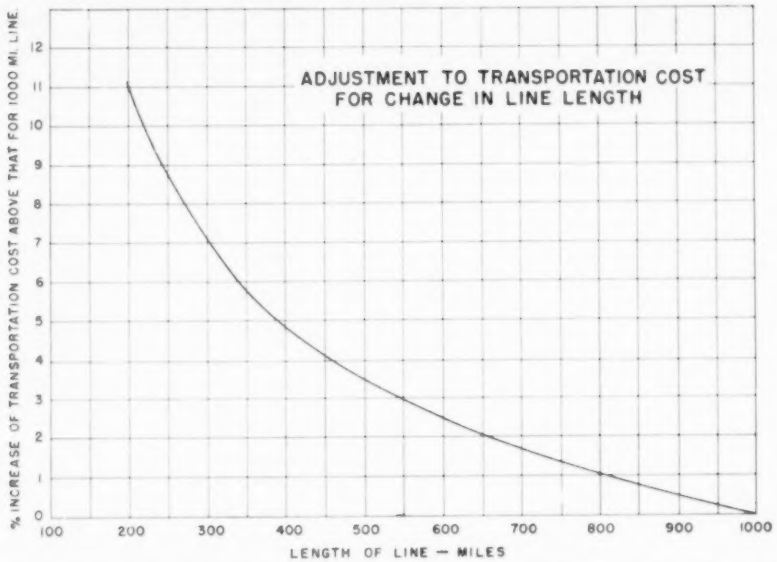

Fig. 1—Percentage adjustment in transportation cost for lines less than 1,000 miles in length.

Here's a short-cut method for

Sizing Crude-Oil Pipe Lines

Many articles have been written describing various methods for the proper sizing of crude-oil pipe lines. This article presents a method that can be used with a minimum of effort and time while affording reasonably accurate results. It should prove helpful in indicating the size of line that will probably be the most economical for a given throughput. This will serve to narrow the range of sizes that must be investigated for any particular design problem. But data presented here should not be used as a guide for measurement of investment and transportation cost for any particular line. The basic principles followed throughout this study were first presented by F. C. Whiteside in *The Oil and Gas Journal*, June 2, 1949.

by W. L. Kennedy, Jr., and Charles C. Stueve

BECAUSE of so many variable factors when it comes to sizing pipe lines, a direct solution is almost impossible. An attempt has been made either to eliminate some of these variables or to modify their effect for a general solution. Ideal conditions are assumed such as: (1) exact station spacing, (2) handling of one grade of crude oil, (3) power availability at a reasonable rate, (4) availability of desired pipe-wall thickness, and (5) reasonable terrain with good construction features. Therefore, any departure from these conditions will in all probability increase both investment and transportation costs above those shown in the charts. A change in recommended pipe diameter could also be caused by variations in these conditions. For these reasons individual consideration must be given to any proposed pipe line in order to arrive at the most economical design.

Principal Factors

In a problem such as this, all but a few of the many variables may be assigned certain values gained through experience and handled as constants. The following list of assumptions contains those factors that are considered to be either constant or variable for the purposes of this study:

1. Length of line . . . This is assumed to be 1,000 miles. This is done to make the solution apply to any length of line except very short ones. This is borne out in Fig. 1, which shows the percentage adjustment in transportation cost for lines less than 1,000 miles in length.

2. Crude-oil specifications . . . These are based upon winter characteristics for an average Mid-Continent crude. Gravity, 37° A.P.I.; viscosity, 77 S.U.s.

3. Pipe grade . . . Since present design trends are directed toward the use of high-tensile-strength steel, the pipe is assumed to be A.P.I.-5LX46 with 100 per cent longitudinal joint efficiency. Maximum allowable operating pressures are obtained through the use of the "A.S.A. Code for Pressure Piping."

4. Line profile . . . This is assumed to be reasonably level with both ends at the same elevation. An infinite number of variations could present themselves if differences in elevation are considered.

5. Pipe weight . . . Consideration is given to the economic usage of different weights of pipe for each nominal diameter. For all cases, the most economical pipe-telescoping arrangement is utilized for each size of pipe—that is, a change is made to the next lighter-weight pipe as soon as the pressure drops to the allowable working pressure of the lighter-weight pipe. This telescoping is done for the pressures encountered in normal operation and no consideration is given to pressures under bypass conditions. The table below shows the minimum wall thickness used for each pipe diameter:

Nominal diameter (in.)	Minimum wall thickness (in.)
10-18	0.250
20-22	0.281
24-26	0.312

6. Pipe and construction costs . . . These are based on prices applicable for the Mid-Continent area in February 1953. These costs include all construction, average freight from eastern mills to Drumright, Okla., coating materials, miscellaneous fittings, right-of-way and damages, engineering, etc. Since this study was completed, steel prices for the sizes and weights of pipe used have increased about 8 per cent. This will increase the constructed cost

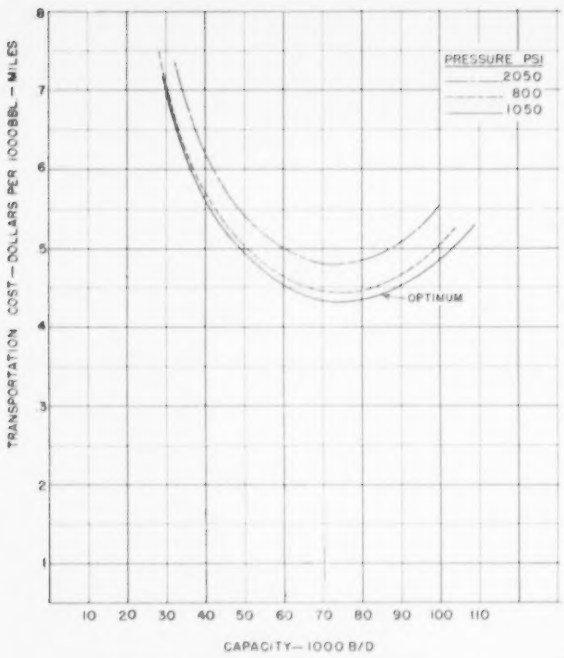

Fig. 2—Determination of optimum pressure.

about 4 per cent, which in turn will increase the transportation cost about 3 per cent.

7. Stations . . . All stations are designed with control equipment and protective shutdown devices to provide for automatic or semiautomatic operations. Remote control is maintained through the use of telemetering. Station investment costs—including site, pumping equipment, manifold, buildings, controls, etc.—are based on electric-centrifugal pumping units. These costs, including installation and construction, are charged in accordance with the following table:

Installed horsepower	Cost per installed horsepower
300- 500	$250
500- 750	180
750-1,000	150
1,000-1,500	125
1,500-2,500	100
Above 2,500	90

8. Tankage . . . This is provided for a 2-day supply of crude at the originating station only. A delivery office is established at the terminus. However, no tankage is provided at the terminus because it is customary for pipe lines to deliver into tankage provided by the consignee.

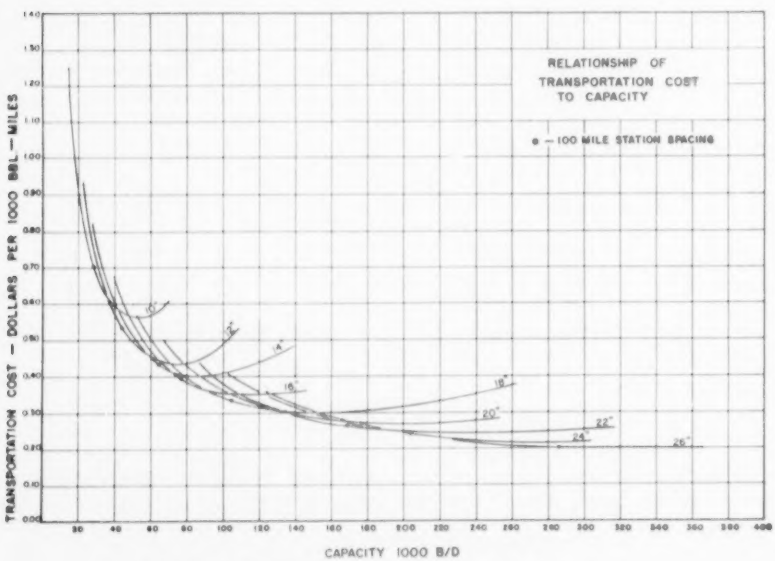
RELATIONSHIP OF
TRANSPORTATION COST
TO CAPACITY
6 — 100 MILE STATION SPACING
TRANSPORTATION COST — DOLLARS PER 1000 BBL. — MILES
CAPACITY 1000 B/D

Fig. 3—Transportation cost curves for each size of pipe.

9. Housing . . . A cottage is provided for the chief engineer at each station when the installed horsepower is above 1,000, and at every other station when the installed horsepower is below 1,000.

10. Communications . . . Two-way microwave communications including voice and telemetering facilities are provided along the entire length of the line.

11. Contingencies . . . An additional 10 per cent of the investment is allowed to provide for contingencies such as major river crossings, maintenance equipment, and incidental operating equipment.

12. Labor charges . . . These are based upon the most recent information pertaining to electric-centrifugal station operation as shown in the following table:

Installed horsepower per station	Labor
Below 1,000	Chief—Every other station
1,000-2,500	Chief—Every station
Above 2,500	Chief plus full crew

13. Power rates . . . These are based on a sliding scale ranging from 8 mills to 12.5 mills.

14. Transportation cost . . . This includes maintenance of facilities; all

THE AUTHORS

W. L. KENNEDY

C. C. STUEVE

W. L. Kennedy, Jr., senior engineer in charge of the hydraulics, civil, corrosion, and evaluation-engineering sections of Service Pipe Line Co., graduated from University of Oklahoma in 1943 with a B.S. in chemical engineering. He joined Service Pipe Line in 1946, following 3 years' service in the Navy. After serving as engineer, hydraulics engineer, and planning engineer, he was promoted to his present position in 1951.

Charles C. Stueve graduated from M.I.T. in 1949 with a B.S. in mechanical engineering. He then joined University of Oklahoma as an instructor in mechanics. Following short periods of employment with Big Chief Drilling Co. and Consolidated-Vultee Aircraft Co., he joined the engineering department of Service Pipe Line in 1952.

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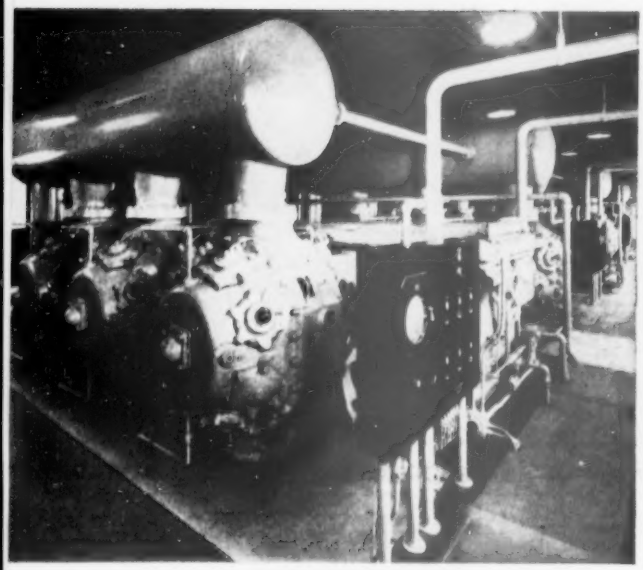
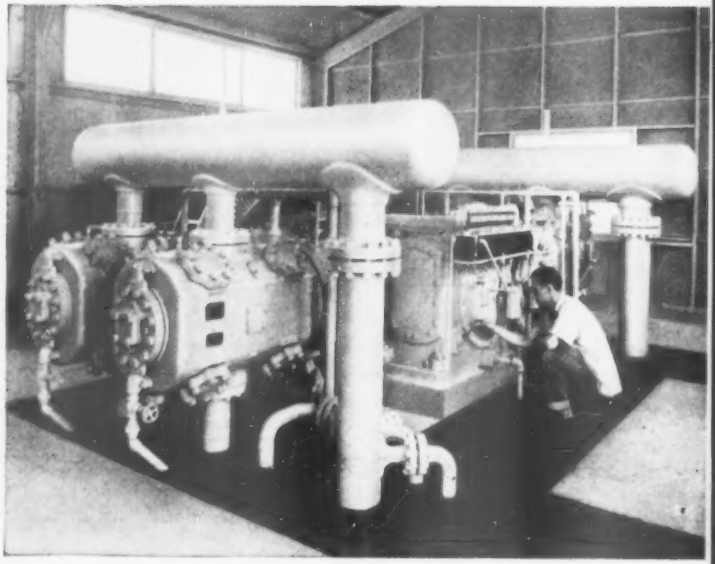
SPACE-SAVING, FUEL-SAVING

Cooper-Bessemers

ON THE P. G. & E. SYSTEM





Above, left: Three Cooper-Bessemer 3,000-hp JM-6 motor-driven compressors in P. G. & E. Point Richmond distribution holder station. Above, right: Cooper-Bessemer 1000-hp FM-4 motor-driven compressor in North Sacramento station, for distribution and underground bottle storage service. Cooper-Bessemer units like these, totaling 17,350 horsepower, are used in six P. G. & E. stations for like service.

ANGLE

Compressors

New York Washington, D. C. Bradford, Pa.

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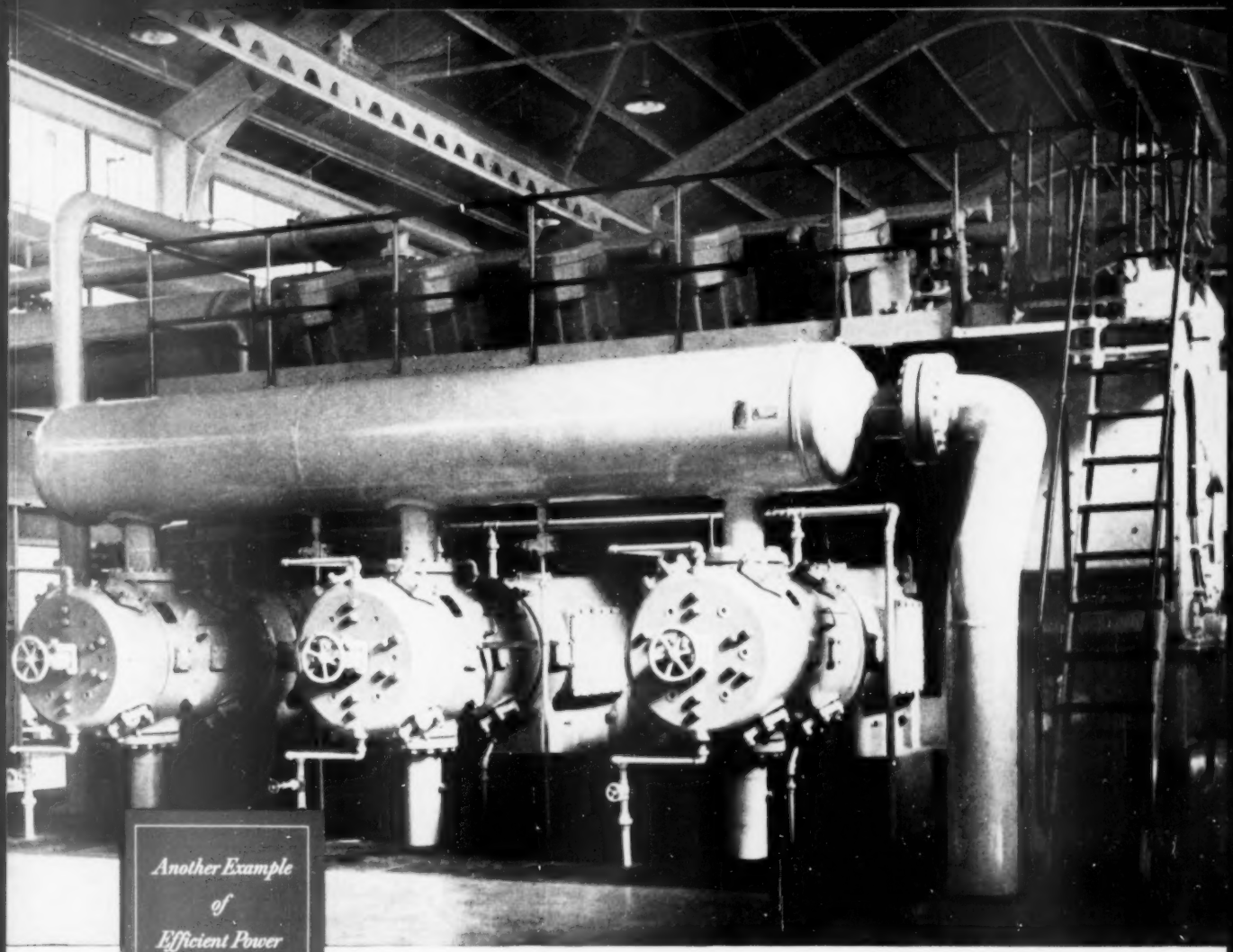


Another Example of Efficient Power at Lower Cost

Line-up of seven Cooper-Bessemer 2500-hp GMW V-angle units in P. G. & E. Hinkley compressor station on the Super Inch Line. The Topock station on the California-Arizona border is Cooper-Bessemer powered with six GMW-10's. These stations, together with a new Kettleman Hills station, have increased line capacity from 250 to 400 millions of cu. ft. per day.

As shown on these pages, modern Cooper-Bessemer compressors, both engine-driven V-angles and motor-driven units, are used in the Pacific Gas & Electric Company system.

On the company's Super Inch Line bringing gas from Texas, big GMW-10's pack low-cost compressor horsepower into relatively small space — six GMW's at the Topock station, seven at Hinkley. And at the third key compressor station, Kettleman Hills, seven 23-year-old Cooper-Bessemer Type 19 horizontals are still on the job, powering the original station serving the first two lines laid north to the San Francisco Bay area. All told, these units total 37,750 Cooper-Bessemer compressor horsepower on P. G. & E. gas transmission lines.

In addition, modern, compact motor-driven Cooper-Bessemer FM's and JM's, as shown at left, provide 17,350 compressor horsepower for distribution and storage services . . . at the company's Hollister, North Sacramento, Modesto, Fresno, Point Richmond and Potrero stations.

You too can rely on Cooper-Bessemers. They provide the most advanced, most economical compressor service to be had today. Check with the nearest Cooper-Bessemer office for the latest information on meeting your compressor needs.

by **Cooper-Bessemer**

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

Tulsa Shreveport St. Louis Los Angeles Chicago

cost incurred in pumping oil, such as power and labor; overhead; depreciation; property taxes; interest; transportation tax; income tax; and a reasonable rate of return on investment.

Operating Pressure

Of the remaining variable factors, another, the operating pressure, is reduced to a constant for each size of line. As the correct operating pressure cannot be assumed, it is necessary to arrive at a pressure for each size of pipe that can be considered as an optimum. This is done by calculating the transportation cost for a range of pressures, station spacings, and throughput for a certain size of line. By plotting the results as shown in Fig. 2, the optimum pressure can be determined by noting which transportation-cost curve dips the lowest. The optimum pressure was determined in this manner for only two sizes of pipe—12 and 22 in. In 1951, Service Pipe Line Co. made an extensive study of optimum operating pressures and station spacing for all sizes of pipe, 10 through 26 in. Since the recent calculations for 12 and 22-in. sizes correlate very well with results of the previous study, it is considered reasonable to make adjustments for the other sizes, thus eliminating the voluminous calculations required.

The results also prove to be in good accord with the study presented in Whiteside's article. The following table shows the optimum pressures for each size of pipe as used in this study:

Pipe size (psi.)	Optimum pressure (psi.)
10	1,100
12	*1,050
14	1,000
16	950
18	900
20	850
22	*800
24	750
26	700

*Calculated optimum pressures.

An interesting result of this study is that the optimum pressure for each size of pipe is approximately equal to the allowable pressure for the lightest weight pipe used.

Transportation Cost

Fig. 3 shows transportation-cost curves for each size of pipe. From these curves the proper size of pipe to install for any particular throughput can be read. A payout type of calculation, if necessary, can be made for the size of pipe indicated over any other size.

It is interesting to note here that the point of minimum transportation cost for a particular size of line is not the point of optimum transportation cost for that throughput. Or, conversely, the optimum transportation cost at a certain throughput is not the minimum transportation cost for that particular size of line. Referring to Fig. 3, a 14-in. line reaches its minimum transportation cost at a throughput of 82,000 B/D; however, the optimum transportation cost for that throughput is given by a 16-in. line. It must be remembered that in this throughput range of minimum transportation cost any one size of line is optimum only in relation to all other sizes of line. It is not the point of minimum transportation cost for that particular size of line.

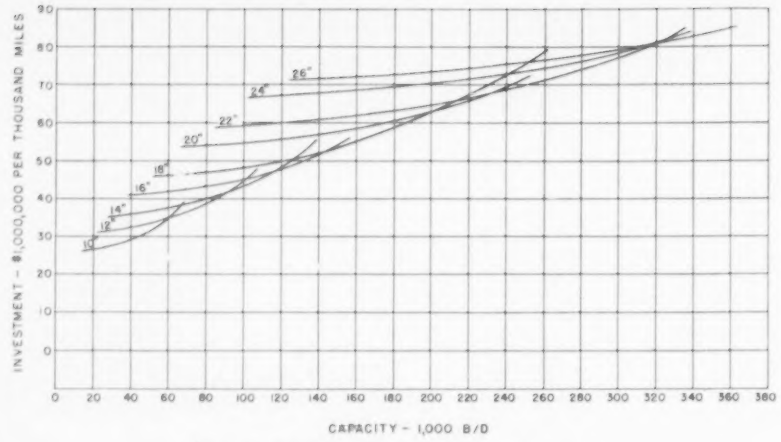


Fig. 4—Total investment per thousand miles.

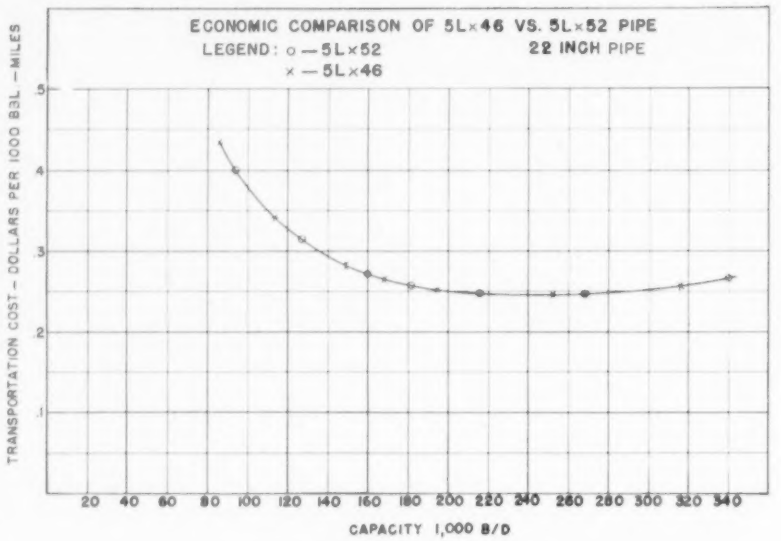

ECONOMIC COMPARISON OF 5L×46 VS. 5L×52 PIPE
LEGEND: o — 5L×52
× — 5L×46
22 INCH PIPE
TRANSPORTATION COST - DOLLARS PER 1000 BBL - MILES
CAPACITY 1,000 B/D

Fig. 5—Comparing two grades of pipe.

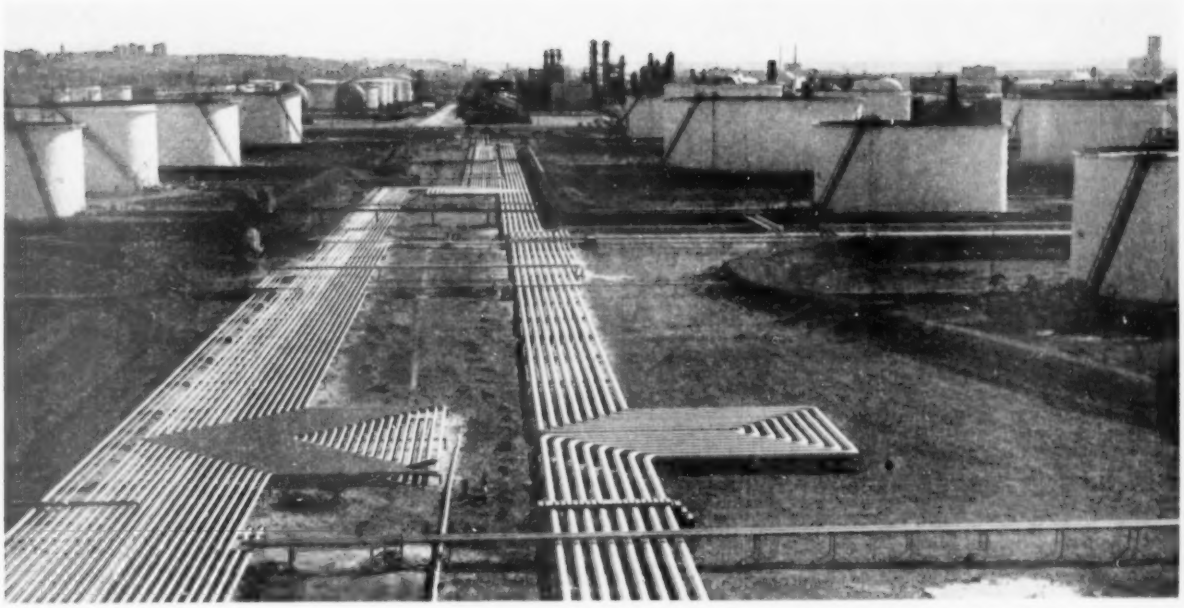
Total investment . . . Fig. 4 shows the total investment corresponding to the curves in Fig. 3. As is to be expected, the minimum investment required for a given throughput does not correspond to the investment for the size of line recommended for that throughput in Fig 3.

Station spacing . . . Another interesting aspect of this study did not become evident until after the completion of the charts. It is this: for each size of line in its range of optimum operation the station spacing is approximately 100 miles. However, if lines are designed on this basis and later a capacity increase is needed, additional stations (particularly for the smaller size lines) provide the most economical means of getting it. In Fig. 3, the point of operation for 100-mile station spacing has been plotted on each curve.

Comparing Pipe Grades

One more point of interest came to light in an economic comparison of 5LX46 pipe versus 5LX52. The calculations were made for 22-in. pipe and the results are shown in Fig. 5. For

(Continued on page 264)



PRODUCTS TERMINAL . . . On products storage, earlier problems of conservation and safety have been largely overcome. Floating-roof tanks are preferred in latitudes where freezing weather is not too prevalent. Loops are provided to allow for expansion.

Why product pipe lines are in today's enviable spot—

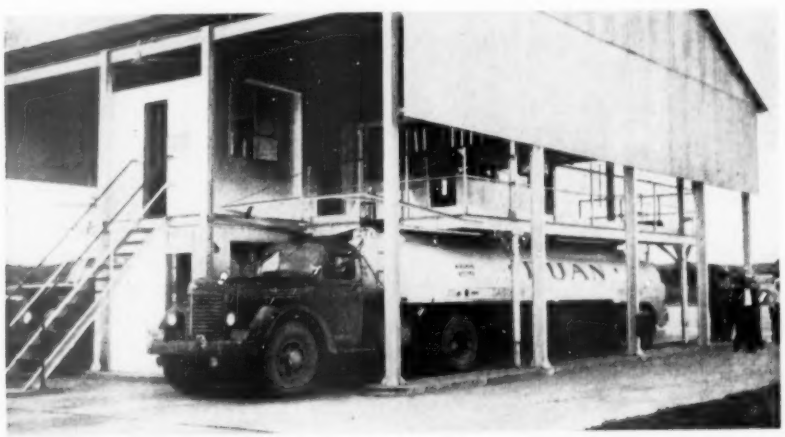
Modern Techniques, Plus Operating Know-How

Depression born, war matured, this industry has forged to top economic position

by C. C. Keane

THE products pipe line which had its inception in the early thirties, has become a carrier of major importance in the national economy. In particular, during the war both as a fuel transporter to augment the nation's productive effort and as a supply system for vehicles of war in the battle front, few services approached it in dependability, economy of equipment and manpower, and safety from sabotage or attack.

Other means of transportation such as rail and truck were released to serve in fields best suited to their characteristics, while the products pipe lines operated unseen and unheard 24 hours a day, year in and out. Had it not been for the sound judgment and engineering techniques basically included in the original systems, plus the manner in which new developments have been conceived and introduced, products pipe lines would not be in today's enviable position. A 10-year review discloses remarkable forward strides.



LOADING . . . Modern products-loading facilities are exemplified in this photo.

Automatic Product Stations

The slow evolution of the automatic and controlled automatic stations received an impetus from the products field that is noteworthy indeed. Several evolutionary phases combined to make these possible. Adequate supply of dependable and reasonably priced electric power is fundamental to the automatic station. Power companies now conside, pipe-line loads an attractive means of leveling the large fluctuations in over-all power station demand, and the electric-power engineer has taken a more enlightened view of the desirability of equity in rates under which the pipe-line company can afford to operate. As a further incentive,

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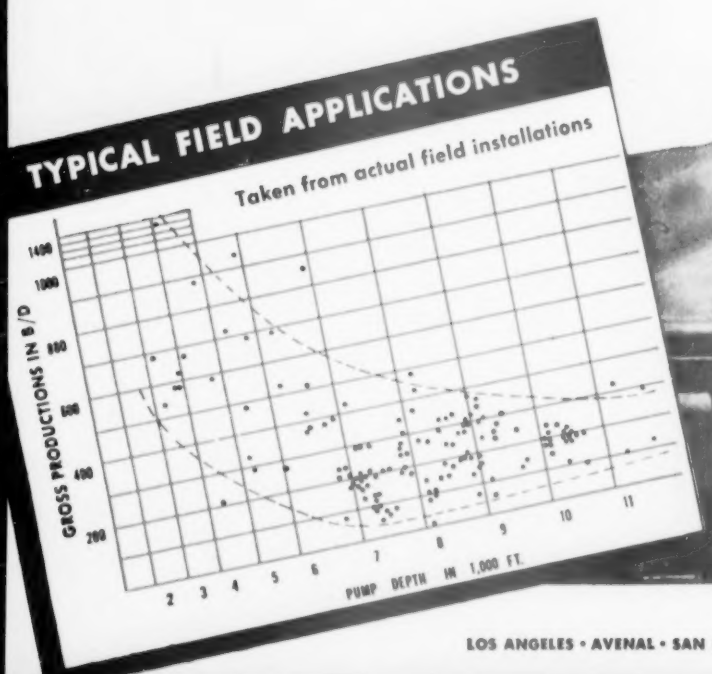

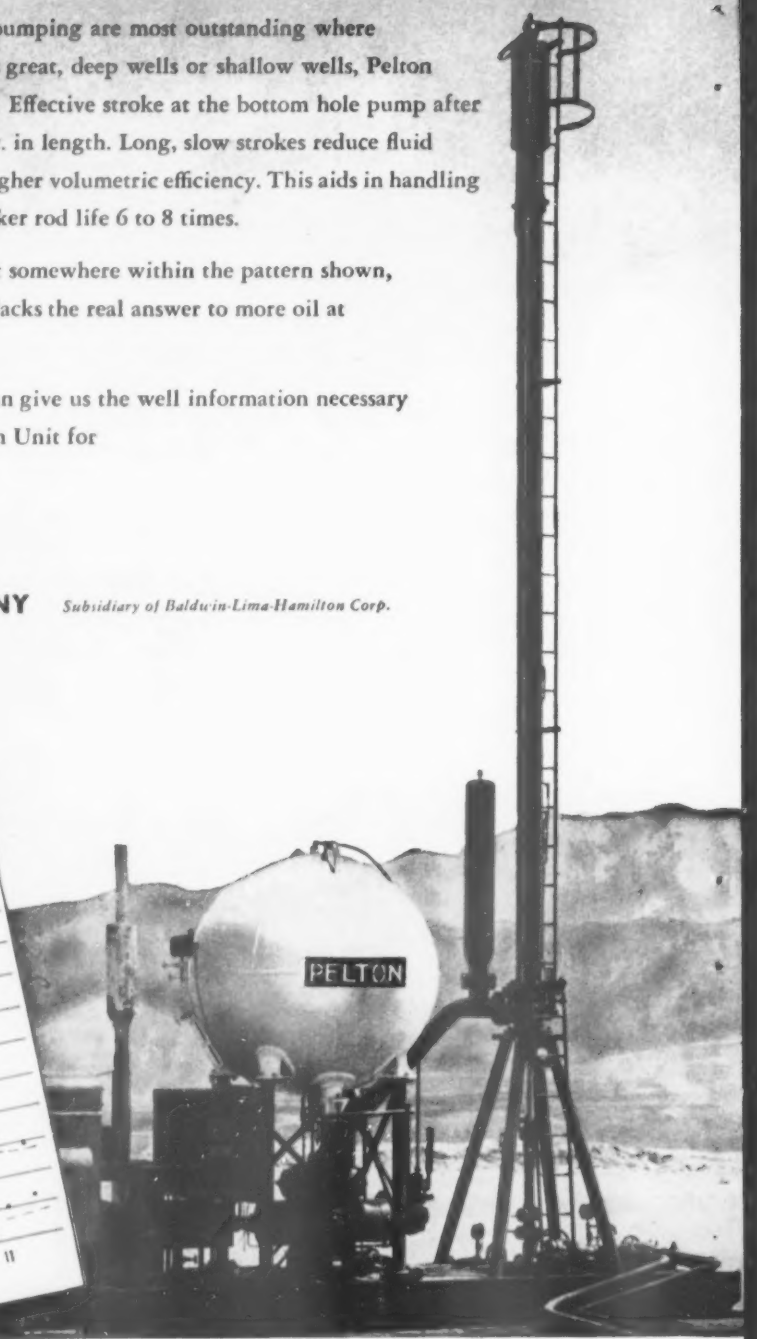

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the power companies have looped and gridded their systems to reduce to a minimum the power outages accepted as inevitable 10 years ago.

Outside ventilated motors . . . In the motor field the mandate that all such units must be explosion resisting is no longer universally accepted. Outside ventilated motors with appropriately designed air-feed systems have proved to be as safe as their counterparts in the explosion-resisting field and are much quieter to operate.

While the diesel engine dominated the power field for many years because of its high thermal efficiency and resulting fuel economy, some of the very factors that made it predominant are now responsible for its being supplanted. Fuel costs have combined with labor to diminish the economic advantage the diesel once held and only in the dual-fuel field do we find it holding an attractive low-cost operating position.

Centrifugal Pumps

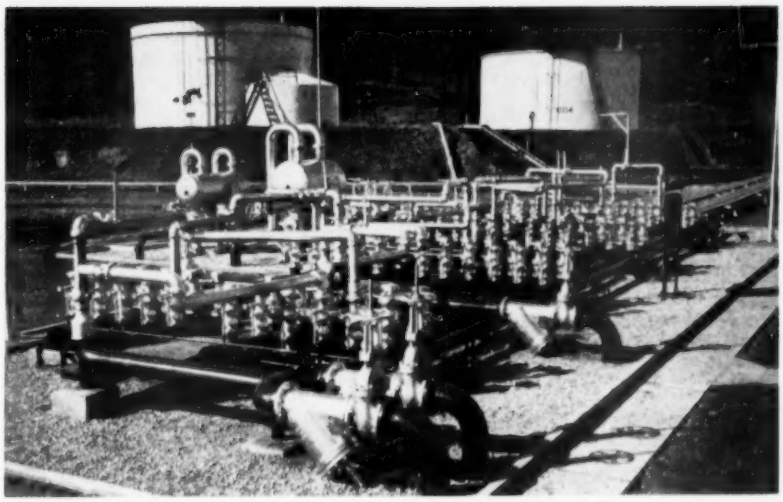
As a counterpart to the forward drive of electric power for dominance has come the centrifugal pump. It makes an ideal coupling unit for a motor and because of its compact design together with an efficiency that very closely approximates its plunger contemporary, the centrifugal pump has practically supplanted the plunger pump in all major products systems.

Its evolutionary period was not without headaches, however, in that the designers learned much from the operating problems present in the early units.

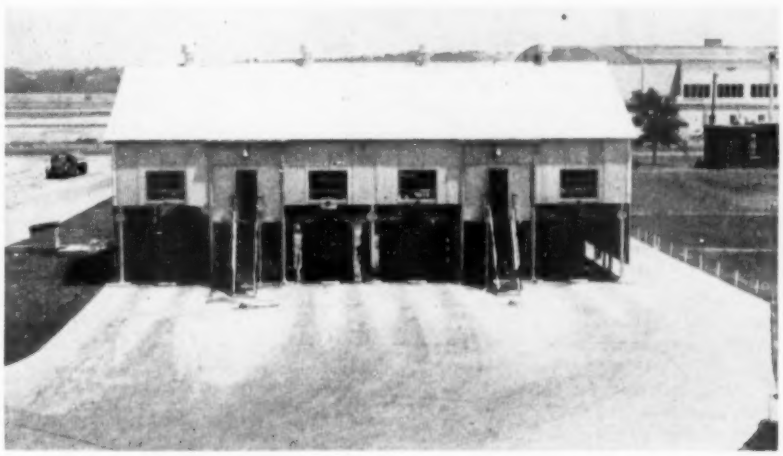
The rust problem . . . Ten years ago the pump designer was convinced high-tensile hard cast iron was the answer to pump trim problems: case rings, stage pieces, bushings, and throat rings were all made of this material. However, the pipe-line operators were then just beginning to understand the dangerous influence of suspended water. The damage it caused took formal pattern in the tons of iron oxide moved in to pumping stations with each scraper run. Rustloads smashed strainers, damaged reciprocating pumps, and completely wrecked the rotating assemblies of centrifugal pumps. Where cast-iron trim was standard, an overnight shutdown was sufficient to produce the galling action that wrecked a motor powered centrifugal pump on starting.

Inhibitors . . . The engineering and operating staff of the systems in use 10 years ago fought and won the battle of rust. Like problems in many other industries, credit for its final solution must go to the research chemists in the laboratories. Strainers, separators, scrapers, settling basins, and many other devices were used and tried, but the basic solution lay in prevention rather than cure. Eventually water and oil-soluble inhibitors solved the problem and as one views the ease with which products systems operate today, it is difficult to realize that not many years ago the bugbear rust was a nightmare that threatened the successful continuance of products pipe lines.

Eventually special bronzes such as barium and phosphor were used in bushing and stage piece assemblies, and while these materials prevented galling between the rotating shaft sleeves and bushings they were not the complete answer. To dependable inhibitors must go the credit for the ultimate solution of the rust problem.



MANIFOLD . . . Today's manifolding systems are designed for maximum ease of switching as shown in this photo of facilities located in general Tulsa area.



LOADING BAYS . . . This photo shows truck-loading bays.

Greater Flow Rates

So great has been the impact of the rust inhibitor that the basic principle on which products lines are designed, namely flow, has been substantially revised in the past 10 years. At the start of this decade the roughness factor in the Hazen and Williams formula considered appropriate for 8-in. lines was 130. This value was reduced after a short period of operation to 125. It was possible to maintain the value at this figure only by constant use of scrapers. As a consequence a 125 roughness factor was basic to 8-in. line design.

Today because of the fine performance of internal rust inhibitors the design roughness factor stands at 160, an increase of 28 per cent over 10 years ago. In the Hazen and Williams formula, since the flow rate varies directly as the roughness factor, and that factor is in the numerator, today's design flow rate is 28 per cent above that of 10 years ago. Specifically this implies that an 8-in. line which carried 1,000 bbl. per hour 10 years ago

THE AUTHOR

C. C. Keane, chief engineer, Great Lakes Pipe Line Co., Kansas City, was educated and trained in mechanical engineering at Vickers Technology School and Nottingham University in England. He established residence in the United States and after extensive travel for De La Vergne Diesel Engine Co. in the United States, Canada, and Central America for modifying and redesigning of power plants, pipe-line stations, and refrigerating plants, he joined the mechanical department of Prairie Pipe Line Co. at Tulsa in 1928. Between 1931 and 1941 he was engaged in several capacities in the operating department of Great Lakes Pipe Line Co. until he was appointed to his present position.

would have under today's accepted standards at the same pressure a throughput of 1,280 bbl. an hour. If the net return were 10 cents a barrel, approximately a quarter of a million dollars additional revenue each year would be expected from an 8-in. line today than from its counterpart 10 years back.

Building Design

What of building design? Here, also significant improvements have been made. The steel-frame corrugated structure of yesteryear, long the accepted standard, has given way to an arrangement more in keeping with the importance of the equipment it houses. Fully insulated aluminum or enameled steel sections arranged to accommodate electric and other services are available for quick fabrication.

Prefabs . . . The new type of building is all factory made and after arrival on the job site, it may be erected in one-quarter the time needed for the usual masonry or brick structure. It is fabricated just as rapidly as the steel frame corrugated barn structure of 10 years ago, and into every feature of its design has gone commendable planning which includes low maintenance costs, ease of assembly, and durable materials. It has an additional advan-

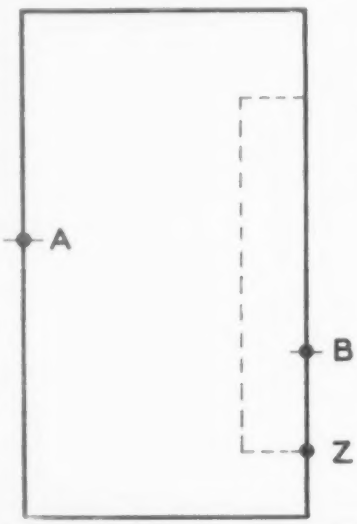


Fig. 1.

The location of the line connections should be as follows:

Gasoline effluent line A (6 + 12 + 16) = 34 in. (see Fig. 2) above the bottom of the tank.

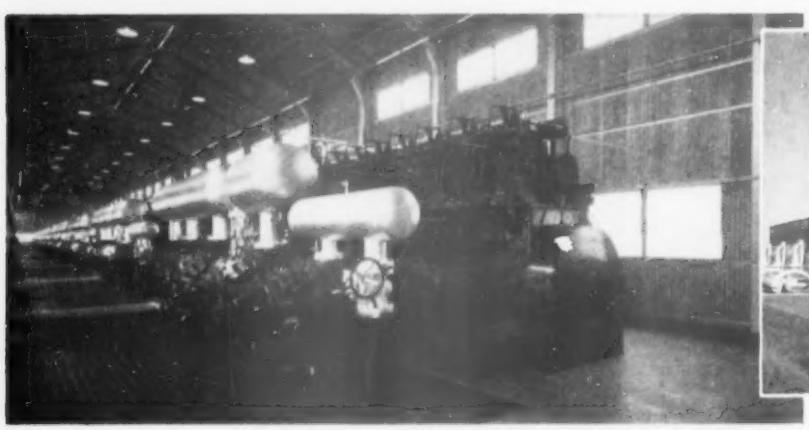
The active part of the water gasoline column is 28 in. above the bottom of the baffle. The water gasoline column consists of:

12 in.—water
16 in.—gasoline

Location B is the position of the water outlet line. It is determined as follows:

$$BZ = 12 + (16 \times 0.73) = 23.68 \text{ in.}$$

AZ — BZ = 28 — 23.68 = 4.32 in. which is the difference in elevation between A and B.



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Walworth 30-inch, Type 49, Cast Steel, Pipeline Gate Valve installed in a gas line.

Walworth 24-inch, Cast Steel, Lubricated Plug Valve on discharge line in gas booster station.

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tage in that damage to a panel section is simply repaired by replacement. None of these desirable features is available in nonmetallic structures.

Heating, ventilating, and lighting details may be included if desired in the prefabricated structure; by this foresight we again see the advantages of modern station buildings.

Auxiliary equipment . . . In the auxiliary equipment field which includes such items as sumps and their pumps, separators, air compressors, standby electric generators, lubricating-oil conditioners, instruments for control, pressure gages both indicating and recording, warning apparatus, valve operators, product detection equipment and a host of others, many improvements have been made.

Separator Design

Separators which are part of the sump system are now practically foolproof. Formerly, it was not unusual to find design details poorly planned, supply lines often too large in diameter for the separating capacity of the chamber and the levels of the water, and product effluent lines frequently located in a rather haphazard manner. As a result of this, the tank overflowed when subjected to overload, and the water seal in the chamber baffle section quickly dissipated when overloading occurred.

Example . . . Assume a mixture flow rate of gasoline and water of 125 g.p.m. to be separated in a tank of 4 ft. i.d. Determine the minimum lineal dimensions of the tank, the effluent line sizes, the mixture supply line size and the baffle location. The completed design to prevent overload beyond the contemplated capacity. The specific gravity of the gasoline is taken as 0.73 and that of water as 1.00. The separating period is to be 1 minute.

Solution . . . The baffle is usually a half section of 20 or 24-in. diameter pipe welded to the tank shell. A 6-in. opening is left at the bottom to provide a portway between the tank water

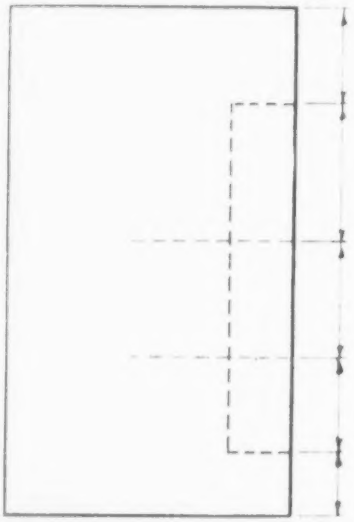

Fig. 2.

12 in. = clearance dimension above top of baffle.

24 in. = height of top of baffle above minimum mixture height.

16 in. = minimum height of mixture above water seal in main tank body.

12 in. = minimum water seal height above baffle bottom in main tank body.

6 in. = distance from tank bottom to baffle bottom.

70 in. = minimum height of tank.

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section inside the baffle and the separating main body of the tank outside the baffle. Because it is conceivable that all water or all gasoline may occasionally flow to the separator, then the inflow line diameter to the tank should not exceed the diameter of either gasoline or water effluent lines. Neither should the head at which the inflow operates exceed the outbound head of either effluent line. If it is not possible to conveniently equalize the head conditions, then a float valve or throttling device should be installed in the inflow line to prevent overloading of the separator. The separator design is now pursued as follows:

Water or gasoline maximum effluent rate = 125 g.p.m.

Settling period in 4-ft. i.d. tank = 1 minute.

Capacity of separator tank per lineal inch = $(48^2 \times 0.7854)/231$ = 7.85 gal.

Minimum water seal height above baffle bottom inside tank main body = 12 in.

Minimum height of top of mixture above baffle bottom for 1 minute settling period = 12 + 125/7.85 = 12 + 16 = 28 in.

Height of top of baffle above minimum mixture height = 24 in.

(See Figs. 1 and 2.)

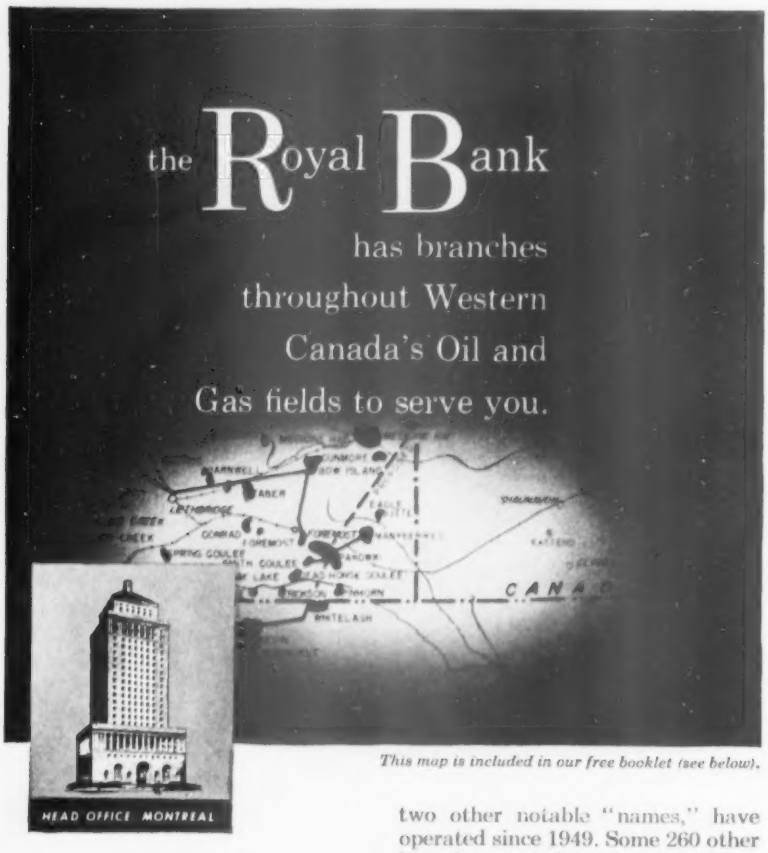
A separator designed to follow this arrangement should prove satisfactory. The total height is 70 in. As an added safeguard the effluent water line should include a check valve to prevent an accidental fire blast from following the line to the tank. The inflow line should be located above "A," and as mentioned before it should have a means of adjusting the rate to accommodate the maximum capacity of the separator. While the foregoing is rather longwinded, it is an outline of the detail essential to the production of a dependable separator. It was selected to illustrate the safeguards used to produce a piece of auxiliary equipment that will meet modern requirements.

Station Controls

In the control field even the diesel station has acquired innovations that would be considered radical risks several years ago. These are principally pneumatic, but hydraulic devices are also playing an outstanding part in this important phase of products systems. No longer is the product float tank considered necessary at relay stations. Whether one or several units be interlocked to supply pump energy to the line, control apparatus is available to govern the rate at which that energy shall be supplied and yet limit the stress imposed by design dictates. It is usual when multiunit assemblies are used in series or parallel operation to assign one for control, while the others may run at fixed speeds or be in turn monitored by the master unit.

Electric unit control . . . Electric units were somewhat at a disadvantage 10 years ago in that flexibility was not an inherent characteristic of the induction motor. Design practice then recognized a fixed duty condition of flow and pressure for a pipe line and deviations below those were accomplished by throttling the discharge of the last pump in the series or if one pump was used by regulating its outflow rate. Energy which in the diesel instance would be saved by reducing speed was wholly wasted by the throttling arrangement.

Eliminate throttling control . . . Recognizing that it was impractical to attempt speed regulation of an induction motor, the pipe-line design engineers turned their energies to the pump end of the power unit. With the aid of the pump designers, a very practical scheme was worked out whereby a series of head capacity conditions were established as standard for a line under design. A so-called half unit was introduced for combining with one, two,



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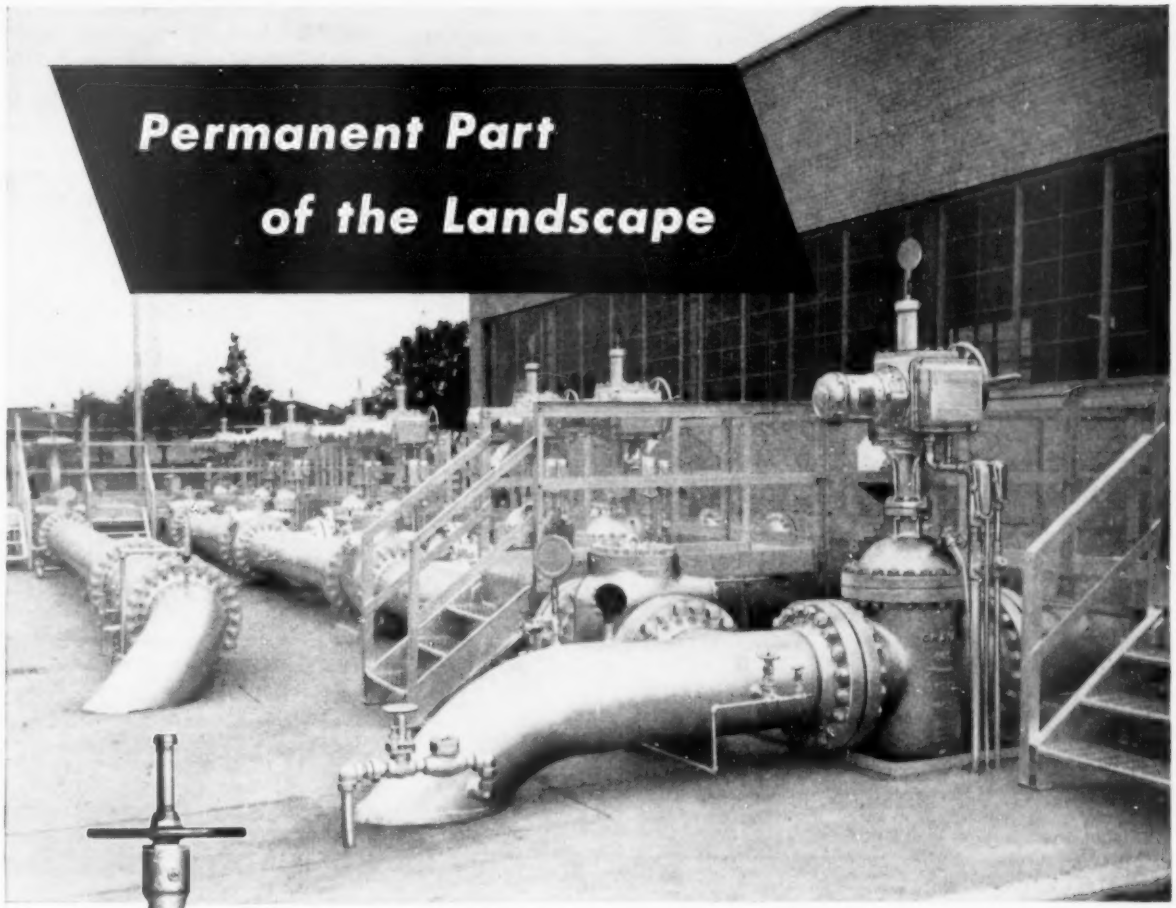

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or three whole units in series. It was thus possible to satisfy six head-condition points on the line without using throttling. This arrangement placed the electric station in a highly competitive position and with more equitable application of rate structures, the electric assembly appears to be assuming a dominant role.

Route Mapping and Surveying

A branch of pipe-line engineering that was stagnant for many years concerned route mapping and surveying. In few other sections have extraneous techniques been so ably applied to expedite and improve a tedious process as in the application of modern photogrammetry to cartographic methods. Ten years ago photogrammetry was in its infancy and what an infancy! Suspicion, doubt, ridicule, and inaccuracies dogged its every step and much of it was deserved. However, it is to the everlasting credit of the camera manufacturers, airplane modifiers, film producers, and the host of auxiliary equipment suppliers that modern aerial photography owes its accuracy, precision, and fine detail. Even the property owners are pleased with this arrangement.

Aerial photographs . . . The photogrammetric engineer has come into his own with a technique that was badly needed by the route planners. This is particularly true in congested areas where products pipe-line terminals are located. Large-scale aerial photographs show with fine accuracy road and rail networks. Stereo pairs outline topography which in turn may indicate rough, hilly areas or other undesirable features. City corporate limits are easily located and suburban developments may be traced without effort. The saving in time and money is substantial. Here, indeed, is a new technique that has lifted surveying out of the doldrums and given it the speed of a modern fighter aircraft.

Strip photograph . . . This has the further advantage of substantial width for future use. It is not unusual to make strips 9 in. wide on a scale of 1,000 ft. equals 1 in. and frequently the line location is such that 3 or 4 in. of photography show on each side of the traverse. Needless to say this record is quite useful in planning to reroute by reason of road or industrial requirements. Aerial photography has indeed come of age and now with the perfection of the airborne radar altimeter at hand, the laborious work of the ground crew should be reduced to a minimum. The past 10 years in this field have been most fruitful.

Pipe Specifications

A demand greatly beyond the capacity of the pipe manufacturers forced the industry to spread as far as was practical allotted steel supplies. The industry Grade B specification was revised to include steels of higher yield point and thus spread the available stocks to a greater number of users.

To further conserve the basic supplies the pipe-line engineers reduced the corrosion factor in design, and by this assented to an increase in the working fiber stress. These figures moved up in the past 10 years from an average design of 17,500 psi. fiber stress to a maximum of 25,000 psi., an increase of 43 per cent.

In tonnage figures for an 8-in. line, this means a steel saving of 20 tons per mile over conventional Grade B as well as a substantial monetary saving in freight and hauling. The increase in yield point from 35,000 psi. to 52,000 psi. introduced a sizable number of construction problems, particularly in the welding end.

XL52 pipe . . . However, with the aid of the pipe fabricators' metallurgists combined with welding technique changes and new electrode developments of the arc machine manufacturers, a feasible and dependable meth-

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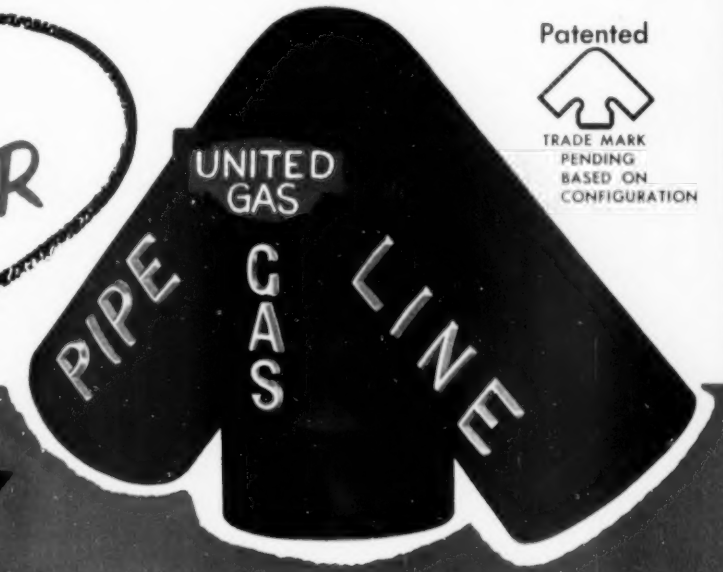

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They dress up your pipe line, Gas or Oil, indicating pride of ownership and good public relations.

Vents and Markers furnished with or without interchangeable brass plate for mile-post and other data.

Furnished with or without company emblem cast integral. Painted in company colors, or unpainted.

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Supplied for solid fillet weld, or with countersunk Allen Head screw.

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od was produced that is now standard in the industry. The so-called XL52 pipe is no longer looked upon as something of a laboratory oddity and its economic advantages are thoroughly understood and appreciated. It is conceded that XL52 will only be replaced when pipe steel or other material of higher yield strength is available and that such new material may be readily field fabricated or welded.

With the advent of high-yield steels which, in turn, called for greater skill on the part of electric welders, it was essential that the weld-testing technique be more precise and dependable. Ten years ago the usual destructive method of weld testing was the accepted standard. It was slow, cumbersome, and not always dependable. As a supplement to the destructive test was the observation skill of the welding inspector, provided he was present when the weld was actually made. However, many welds were completed that were not under direct scrutiny of the inspector during application and as a result only superficial inspection of the cover pass metal was possible. When using heavy-well Grade B pipe, this test method was acceptable, particularly since safety factors were quite liberal.

Nondestructive testing . . . Following the general use of high-yield steels where safety factors are appreciably reduced, it was essential that portable industrial X-ray be made available. As a contemporary, atomic energy in the form of gamma rays also came into use. Radioactive cobalt was the most generally accepted atomic energy source, although radium has been used occasionally. The skilled radiography technician supplemented the welding inspector and while all welds were not photographed, the psychological effect on the welders influenced the production of first-class workmanship. The X-ray technician is now part of the company inspection personnel on all major construction jobs and as fabrication codes become the accepted standards, it may be mandatory that X-ray records of all welds in specified areas be available for analytical use.

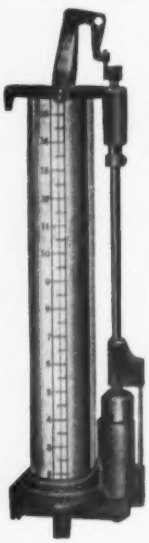
Field Bending

In the construction of 14-in. lines and larger, factory-made bends have given way to the field-bending machine. Speed, accuracy, and correction of errors have been primarily responsible for its development and while the products industry cannot lay claim to its evolution, the field-bending machine has come into extensive use where large diameters are a factor. The precision and tolerance with which bends may be produced relieves the ditch inspector of providing meticulous trench dimensions essential where factory bends are being used. The bending machine has filled a much needed requirement, and as long as metallic pipe is used, it is here to stay. It is a development of the past 10 years.

Preventing Corrosion

Coating and wrapping together with cathodic protection have become factors of sizable prominence in the products field. They are equally as important in the gas-transmission and crude-oil pipe-line industries, and the products group lays no claim to singular developments that gives it dominance in cathodic techniques. However, since products lines are the newcomers in the pipe-line industry as a whole, their sponsoring and technical groups were not traditionally tied to the skepticism which greeted new theories. While it would be incorrect to contend that the cathodic theory was universally rejected by the pioneers in the industry, there was a decided resistance to change which so frequently greets new ideas.

Time, particularly during the past decade, has proved that a combination of insulating coating plus adequate cathodic protection is a definite



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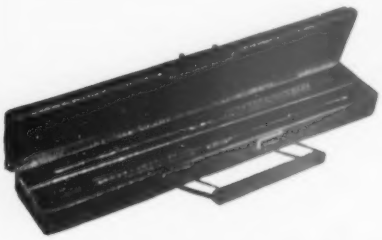

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Because Marvel Synclinal Filters may be disassembled, cleaned and reassembled in a matter of minutes by any workman, filter maintenance "down-time" is reduced to the absolute minimum. Line types operate in any position and may be serviced without disturbing pipe connections.

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Marvel Filters are available in sump and line types, in capacities from 5 to 100 g.p.m. and in monel mesh sizes from 30 to 200. Depend on Marvel Synclinal Filters for all your filtration requirements.

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To qualified engineers and operators in oil companies and contracting firms we will send a MARVEL SYNCLINAL FILTER to test and inspect before purchase. Please advise type, (Sump or Line) G.P.M. and mesh size you desire for this purpose.

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for installation on Hydraulic Systems in GEOPHYSICAL DRILLING RIGS
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for Installation on Crank Case Lube Oil Filtration
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guarantee against the ravages of corrosion. It is admitted that in the Middle West in general, one rarely finds more than 5 per cent of a given run of pipe corroded badly enough to leak. If that information is correct then not more than 7 per cent of any pipe run should be coated, wrapped, and cathodically protected. The problem is—which 7 per cent?

If this could be initially determined, would it be correct to assume that corrosive sections insulated and cathodically protected during construction would remain fixed for the life of the pipe, or would they be vagrant and shift location indiscriminately with time? Perhaps the next 10 years will bring an answer.

Good insulation . . . The extreme importance of maintaining good coating insulation and electric potentials that will protect the steel against coating imperfections is mandatory, particularly in industrial areas. The damage resulting from a leak if fire occurred in congested districts would far outweigh in monetary loss the cost of a first-class coating and cathodic installation.

In the decade just past, the corrosion engineer has learned to be somewhat less dogmatic about the whimsies of nature and the vagaries of artificial electrolysis as they effect his problems. Because of the serious damage that may be done to underground metallic structures owned by others, he is very careful to check "before and after" soil-potential conditions when installing cathodic systems. Particularly is this true where railroads, underground telephone cables, water and gas lines, and petroleum lines owned by others are concerned. Here, community effort is the watchword, rather than the individual approach of a decade ago.

Cathodic instruments . . . Many new assemblies have made their appearance; perhaps one of the most practical is a packaged unit comprising high and low-resistance voltmeters, ammeter, and internal source of testing potential. It may be used for adjacent and remote pipe-to-soil potentials in conjunction with an interrupter.

Also the high-frequency meter generally known as a Pearson detector is quite effective in locating coating breaks. This instrument has also been very helpful in leak-location work on fully coated lines, the theory being if a leak exists it will break the coating bond.

A rather new technique known as surface potential determination has been developed, and from the information thus obtained correlation has been established between surface potentials and corrosive soil conditions. Test leads at 1-mile intervals in addition to insulating flanges at 5-mile locations are essentials to pipe-line systems and are classed as necessities today. Precise records which are brought up to date at frequent intervals, both in tabular and plotted form, provide a graphic pattern that allows quick analysis of line corrosive environments.

With so many new tools and performance records that show leaks from corrosion to be practically nonexistent, is it any wonder that the corrosion engineer has come to be classed as an absolute necessity in the pipe-line maintenance field?

Uncoated lines . . . A further development that has acquired prominence in the past decade is a method of economically protecting uncoated lines against corrosion and the leaks that result therefrom. While the approach is somewhat negative in that rectifier ground beds or magnisum anodes are installed along line sections to arrest

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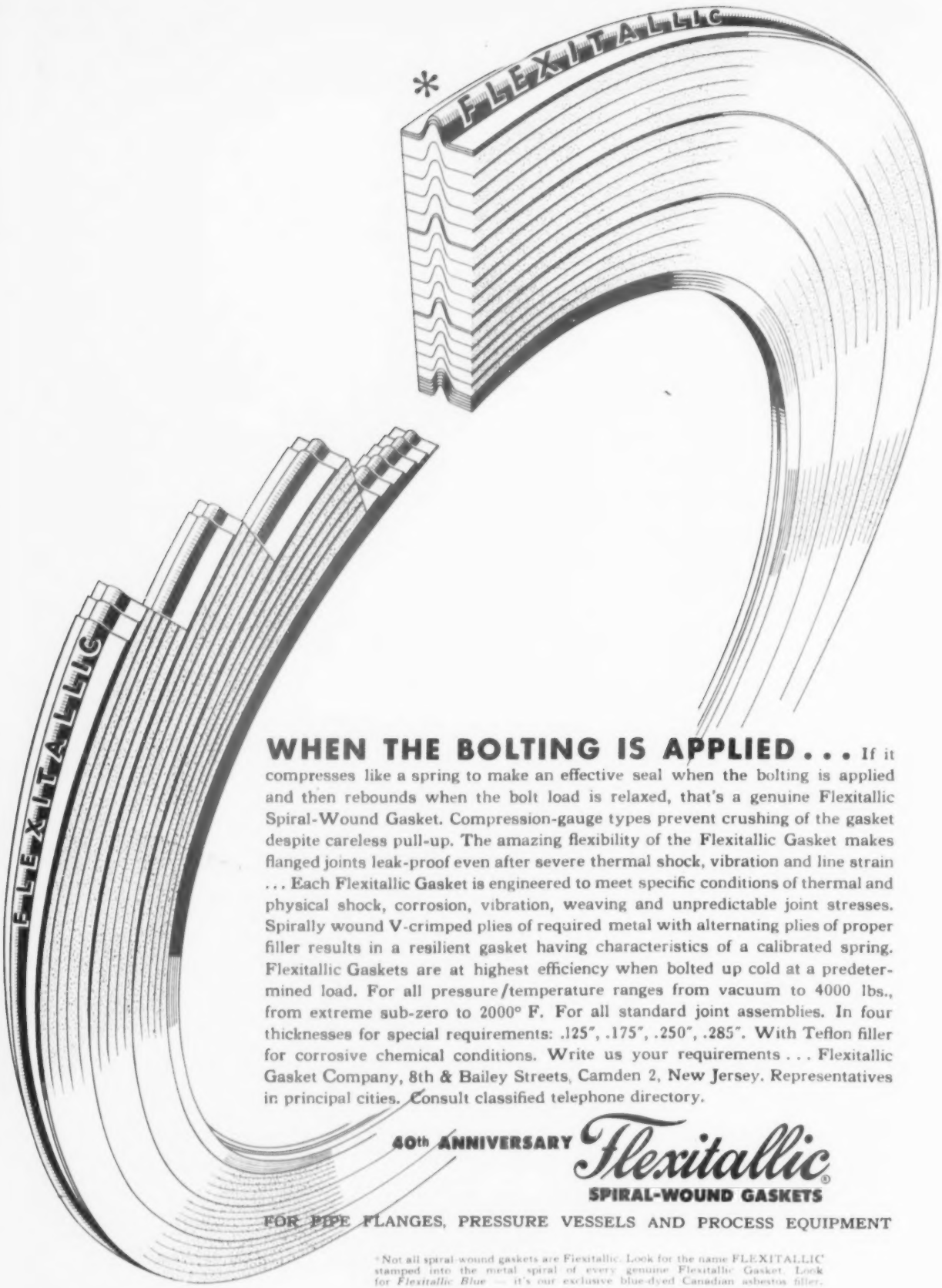

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known corrosive conditions, the technique is a distinct advance over the old dig-and-repair method. Experience has shown the process to be economical, dependable, and far less objectionable from the landowner's point of view than the system used by maintenance gangs. While time alone will tell the over-all efficacy of the scheme, it can be undeniably stated that to date it has been most effective.

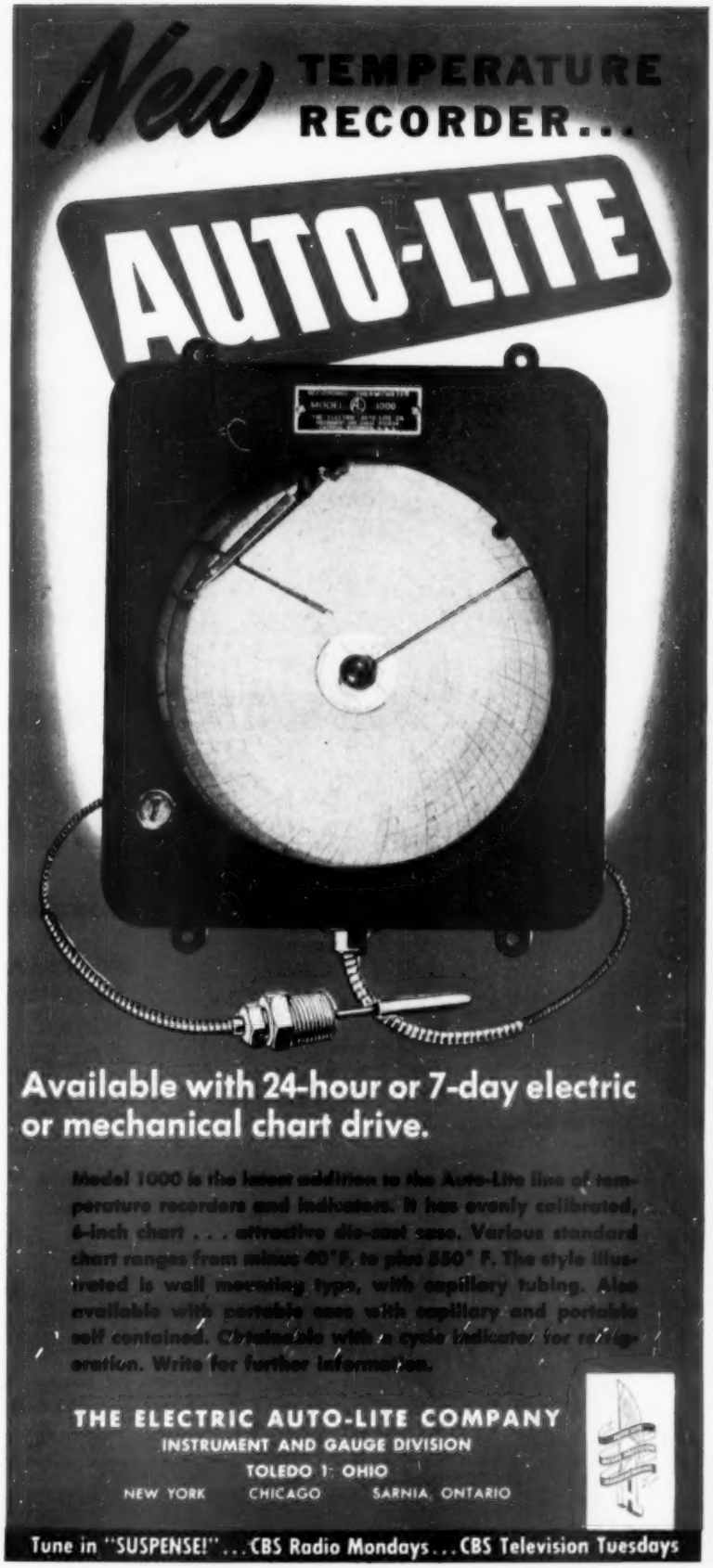
Terminal Marketing Requirements

In products systems where terminals are owned and operated by the pipeline companies, the problems of design, peak loading capacities, segregation of products, minimum storage requirements availability of highway and rail networks, freedom from zoning restrictions, adequate room for expansion, reserve potential and sufficiency of electric power are all factors that must be considered and evaluated.

Ten years ago few indeed foresaw the tremendous increase in the demand for refined petroleum. If one had had the temerity to predict system increases of 100 per cent or more, he would have been classed as an optimist with little basic judgment. Be that as it may, the prognostications following the war's end badly underestimated the national demand for refined products. The yardstick by which it was gaged lacked the fundamentals in its makeup that allow an accurate estimate of area requirements. Particularly was this true in agricultural areas where mechanization by way of the internal-combustion engine had completely supplanted the horse of prewar years.

By reason of inaccurate marketing information, stemming no doubt from a natural conservatism furnished by potential users of pipe-line systems, facilities constructed to satisfy distribution terminals were wholly inadequate. As a result of this, the pipe-line statistical groups were forced to look very deeply into what constituted a marketing area, what its total potential should be, and what percentage of that potential the pipe line should carry. Also it was essential to know if the market was seasonal and if so, in what manner the fluctuations affected the pipe line's capacity to satisfy peak demands.

Electronic computer . . . Again a new tool and technique appeared on the industrial horizon to help analyze and integrate the staggering volume of statistical detail. It was introduced to the public as the electronic computer. The amazing speed with which it digested statistics and produced orderly patterns out of chaotic compilations is little short of miraculous. While this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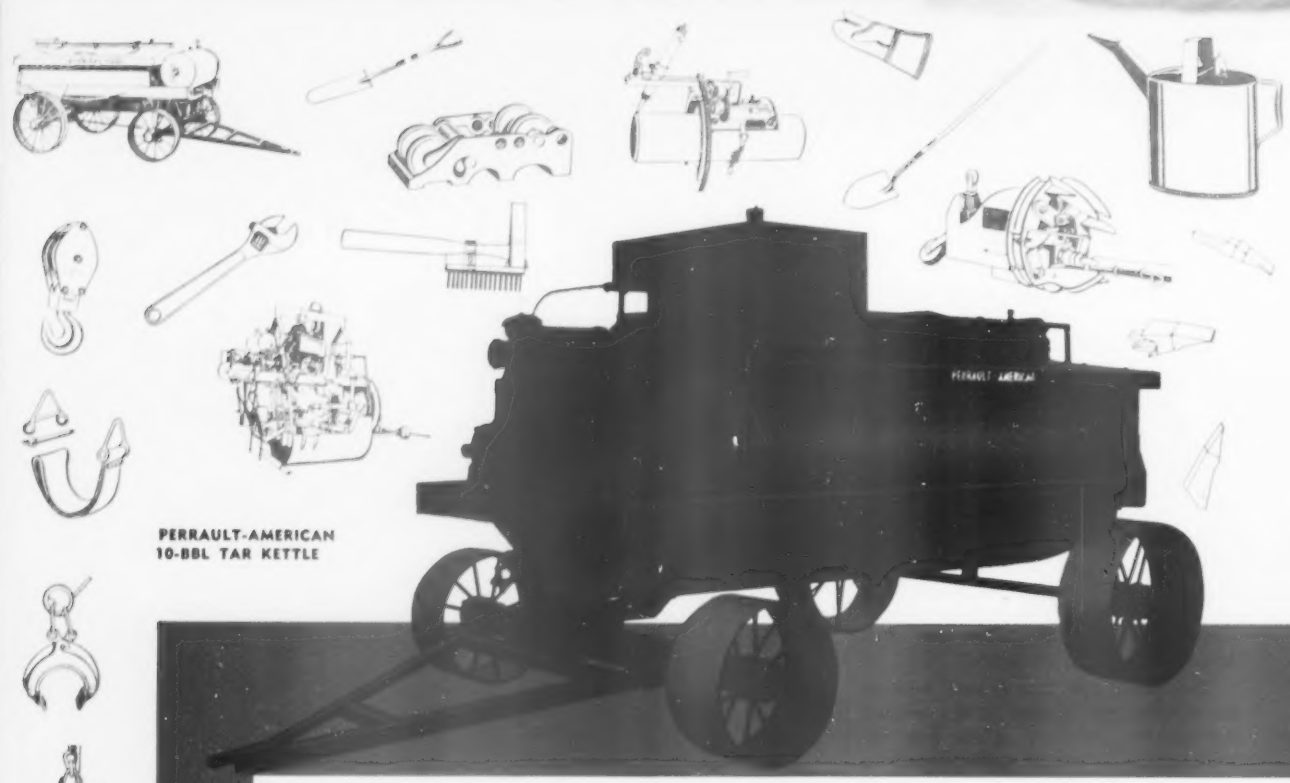

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DIMENSIONS	
HEIGHT, overall	83"
WIDTH, overall	93"
LENGTH, total	190"
LENGTH, without tongue	142"
WEIGHT, shipping	5750#

MELTING TANK: Welded steel plate. FURNACE SHELL: Welded steel plate. MECHANICAL AGITATOR: Linkage of scraper bars scrapes entire bottom of tank, completely eliminates coking. Powered by Wisconsin model AHH engine with clutch. MOUNTING: Four steel wheels with 12" wide treads. BURNERS: Kerosene type.

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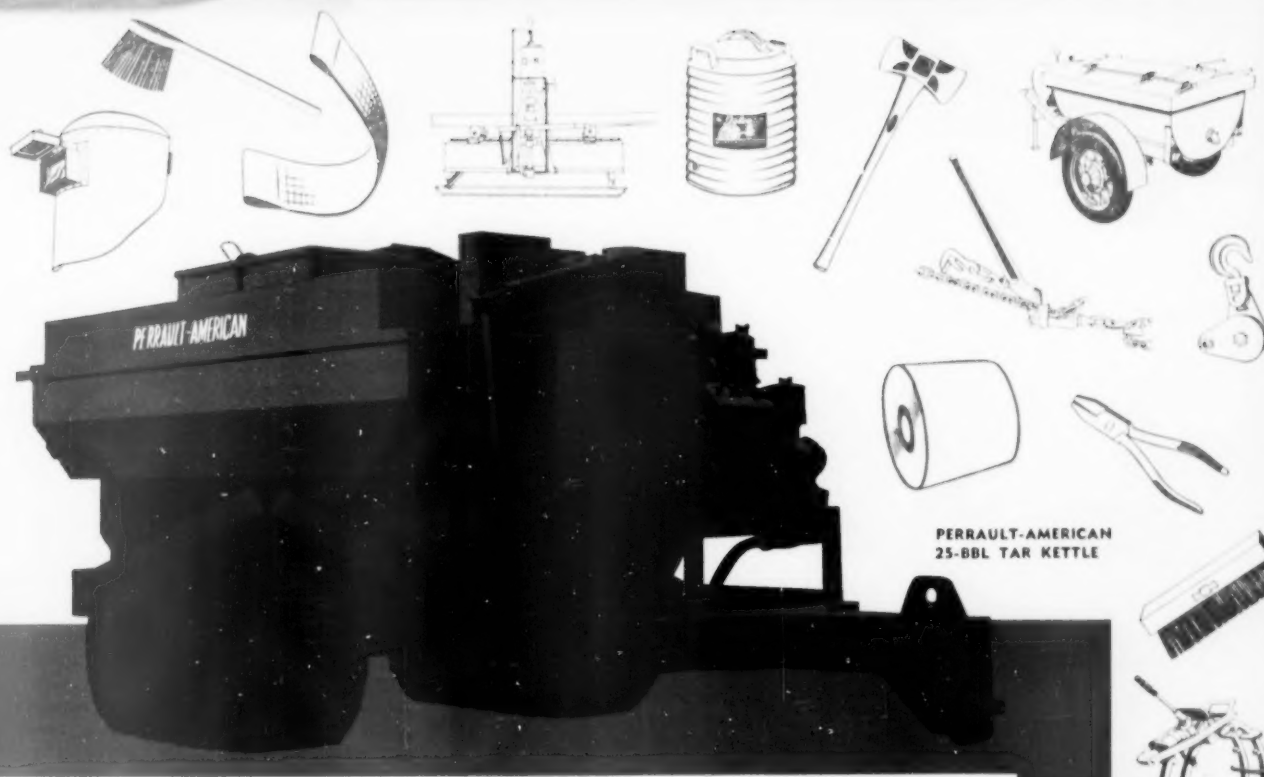

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DIMENSIONS

	With Steel Skids	With Athey Tracks
LENGTH	182"	232"
WIDTH	96"	96"
HEIGHT	84"	96"
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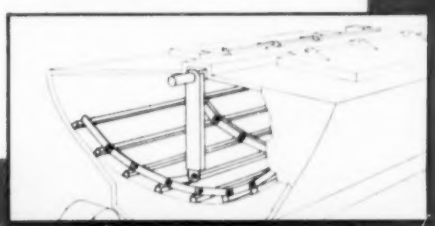

CROSS-SECTION DIAGRAM SHOWS DESIGN OF PERRAULT-AMERICAN MECHANICAL AGITATOR LINKAGE OF SQUARE SCRAPER BARS.

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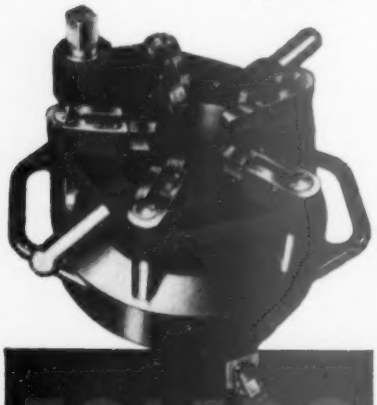

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approach is all quite new, it has disclosed a rather clear picture of what to expect in a terminal marketing area. It also provides trend information that helps resolve the problem of line reserve when planning new networks. Finally, terminal-storage requirements may be determined within acceptable limits and most desirable of all, line-movement schedules may be adjusted to assure full optimization of the design capacity of the system as well as the volumes required at the various origin points to accomplish this end. Here indeed is a mechanism and technique which, while in its infancy, does fall within the 10-year period under survey.

Storage

While meticulous analysis of statistical data will provide answers to the volume of storage essential at each terminal, it will not furnish engineering answers to the type of storage to use. In its formative years the products industry generally decided that floating-roof storage was the complete answer to the conservation and protection against fire of refined volatile liquids.

Weather effects . . . While this concept was not incorrect other factors assumed a dominance that could not be overlooked, in particular the complete prevention of water entering products by way of rain became a mandate. Also the operation and maintenance of floating-roof storage in latitudes where ice and snow were substantial factors could not be overlooked. Weather blizzards frequently make the operation of floating-roof storage decidedly difficult. Snowdrifts on the roof deck cause tilting and binding and the additional load makes gaging inaccurate because the roof submergence in the product is greater than normal, hence the liquid level is higher and indicates a ficticious volume.

An operating feature which causes particular trouble develops when outside temperatures range above freezing and product temperatures are below it. In this environment a roof snow load begins to thaw and water running between the tank shell and roof shoes freezes to the shell at a level slightly below the roof structure. The result is an ice barrier of spears that punches holes through the sealing fabric of old-style roofs which in turn makes them ineffective until repairs are made.

Floating-roof assemblies were such a decided improvement over conventional cone roofs that the very idea of supplanting them where weather conditions demanded was considered a lowering of standards. The complexity and essential flexibility of terminal pipe-line net works which made it absolutely necessary that lines be above ground, did more to dictate the type of tankage than any other factor. With aboveground lines as a basic policy, every possible means had to be taken to eliminate water. Since floaters are prone to trap water, it was not possible to reconcile this with a line pattern exposed to the elements.

Expansion storage . . . Tanks with

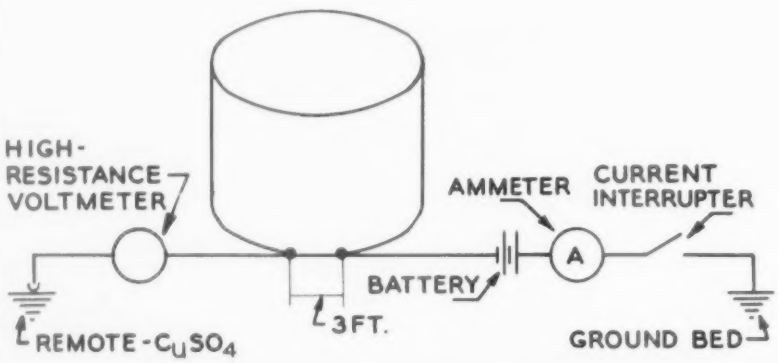


Fig. 3.

1. **Permit current interrupter to energize tank bottom using approximately 30-second on and 15-second off cycle.**
2. **Measure current flow.**
3. **Measure on and off voltages of tank to remote soil potential using copper sulfate reference electrode.**
4. **Take several readings (at least five) of current and voltages.**
5. **Then, calculate resistance of tank bottom to earth for each of above readings using following formula and average these values for actual resistance to earth of tank bottom:**

$$R = \frac{\text{Volts On} - \text{Volts Off}}{\text{Current}}$$

$$= \frac{AV}{I}, \text{ ohms}$$

sealed vapor systems which are rain resistant seemed to fit terminal requirements more closely than their better known contemporaries, the floaters. Also theoretically at least, their conservation characteristics appeared to be as good and the effect of snow and ice had little bearing on their operation.

Safety . . . It is admitted that from a fire-hazard standpoint expansion storage may not be as safe as floaters. However, tests have shown that the vapor space above the liquid has not been found to be in the explosive range. If similar tests made by a dependable recording explosion meter over a period of time show mixtures to be too rich for combustion, then it might be logical to conclude that little or no fire hazard exists. Flame arrestors in all openings that relieve pressure or vacuum are usually satisfactory to stop flame travel into a tank vapor space. Since lightening is responsible for many tank fires and liberally designed flame arrestors effectively stop fire travel initiated by lightening, the logical preventive arrangement is dependable arrestors plus proper grounding of the shell.

The circuit detail and methods by which storage tanks may be checked to assure an acceptable ground is illustrated in Fig. 3.

It is now acknowledged that floating-roof tanks have a competitor which has been developed in the past 10 years and for at least 5 of these it has performed very creditably.

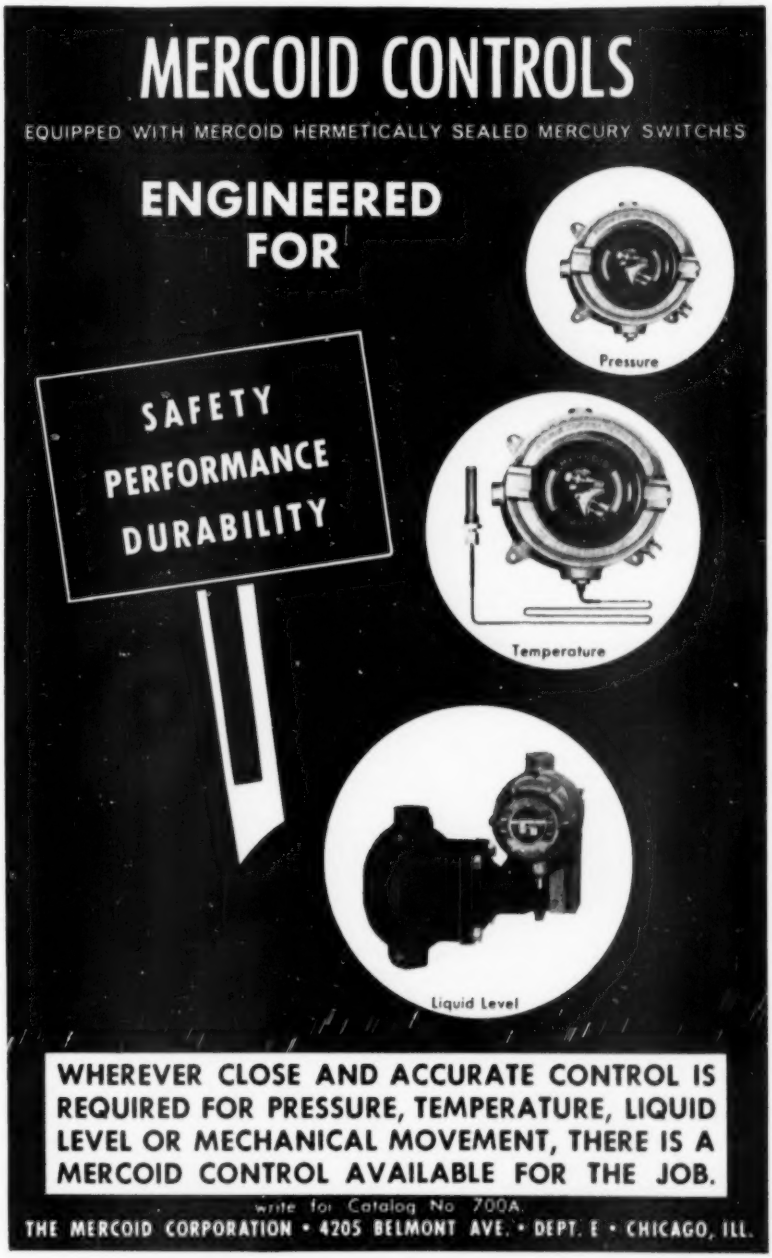
Remote gaging . . . Remote electric gages in their infancy 10 years ago have successfully weathered the probationary period and are now quite dependable. The problem of uniformity in temperature measurements of standing storage has been under scrutiny for some time, and tests now under way utilizing scanning resistance thermometers may change methods long accepted as standard. The resistance thermometer by reason of its large volume coverage will give a much closer average of the temperature of the liquid than the spot check method now in use.

Venting . . . The basic design of pressure and vacuum vents for expansion and cone-roof storage is undergoing a radical rearrangement. For many years this equipment followed an accepted pattern of opening at one pressure and closing at another, the difference between the two being a recognized leak period when pressure was involved. The designers attempted to narrow this period by pilot apparatus and other precision methods, but basically the valve assembly was little different from the original.

More recently, however, a new theory has been evolved which offers considerable promise. The leak period has been reduced appreciably and the valve is droptight up to the very instant it opens. There is no jogging of the pallet and it goes to the full open position immediately, when the pressure for which it is set is attained. The closing operation is also quickly accomplished and the valve is again droptight. Because the seating material is oil-resisting sheet rubber which maintains its resiliency throughout a substantial temperature range, maintenance should be low and dependability high for this equipment. It is a decided improvement over metallic pallet valves which heretofore were standard.

Fire Protection

The approach to fire protection has undergone sweeping changes in the decade under survey. One of the major oil companies put into experimental operation a method of extinguishing crude-oil tank fires by introducing air under pressure at the bottom ring of the tank to force the liquid mass into a rolling motion from bottom to top. The continuous rolling causes cool liquid to constantly move into the zone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of the fire at a rate sufficiently fast to prevent vaporization. Since vapor is essential to support combustion and its formation is prevented by this technique, the fire quickly dies out when the air forces the liquid mass to roll. The method is also effective in extinguishing refined product fires if the liquid vapor point is above the ambient temperature.

It is not known whether pump energy would accomplish the same end as the air pressure, but if it should then terminal tankage equipped with eductor nozzle circulating through pump spiders might very well utilize this system to fight tank fires.

Metering

The past decade also has brought about a decided increase in the use of main-line meters. Several manufacturers are now offering high-pressure meters which are four times larger in volume than those in use 10 years ago. Temperature-compensating devices are available for use on this equipment if desired, and where flying switches of streams are necessary a gear-shift mechanism may be used to align a new recorder and printer for volume indications to the switched supply point.

Gearing assemblies also are available to combine the output of several meters in one recording and indicating counter. Electronic counter assemblies are being used for remote transmission of metered information, and it is in this field that metering may well get its greatest boost. Adder circuits are now available to total the output of many meters on one tape, also the so-called catchup circuit has passed the experimental stage.

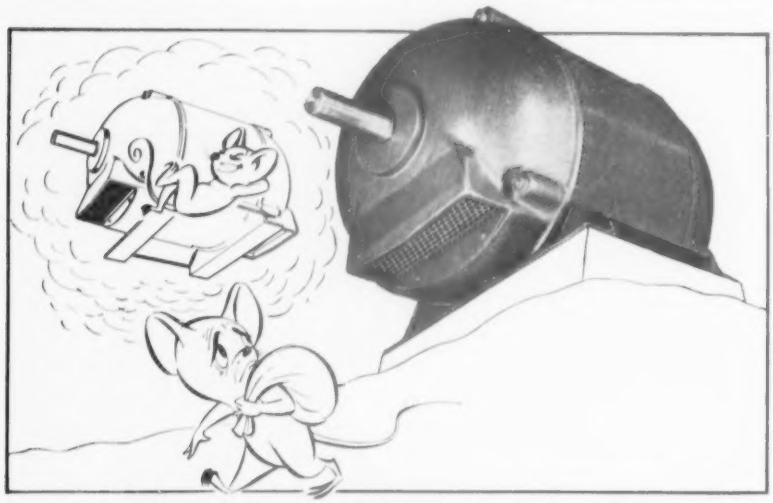
Electronic counter . . . With its successful development, it is expected that an electronic counter may be used to gather information from large batteries of meters scattered at remote points on a tank farm or terminal. In use, the counter is aligned electrically to the meter it is to check, and then it is run at high speed until it catches up with the meter count. At that point it locks into synchronism with the metering unit and the operator may record or print the information. It may be switched to as many meters as the operator can handle within the allotted time unit.

Valves

In a products pipe-line system one of the basic requirements in the piping design is an assurance that absolute separation must be maintained between materials of different specification. Since seasonal demands and increases in area consumption require piping networks be flexible to the greatest possible degree, it behooves the designer to interlock receiving, transfer, and delivery facilities to achieve this and to produce an economic design. With this end in view it was mandatory that gate or plug valves, which are practically always the connecting links between pipe arteries, be absolutely leak resistant under stress and temperature variations.

The valve manufacturers tried valiantly to supply the industry need during the late thirties and early forties, but precision machine work alone was not the solution to a leak-resistant valve. To compensate for distortion of the valve body when under stress, it was essential to design resiliency into the standing or traveling section of the assembly. Several manufacturers are now marketing valves with resilient sealing members made from petroleum-resisting rubber. While these are a distinct improvement over the all-metal solid-tongued units, there has not been a sufficient test period to assure users that they are fully dependable. Without a doubt, however, the valve manufacturer has made a design contribution in the proper direction during the 10-year period just past.

Many problems still remain to be solved in the engineering, construction, and operation of products pipe lines. Time and technological developments should provide the answers.



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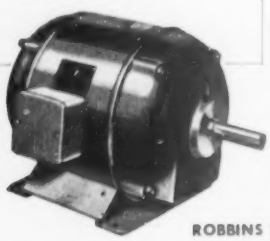

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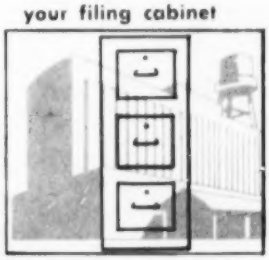

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by T. M. Ragland

CATHODIC protection has become a definite part of practically all major pipe-line systems during the past decade. When properly applied, it will practically eliminate the extremely destructive attacks of galvanic corrosion on buried steel. As the use of cathodic protection becomes increasingly widespread, the insulated flange is being specified and installed at a proportional rate. These insulated flanges are often installed, maintained, or changed by personnel whose duties do not necessarily include corrosion control. Consequently, they often do not understand the reason for pipe-line insulation, the proper method of installing it, or its importance in an effective cathodic-protective system.

What Material?

No single material is satisfactory for every application. The material for each application is selected after consideration of: (1) resistance to attack from the atmosphere, sun, and fluid being transferred; (2) thermal characteristics at the operating temperature of the line; (3) electrical resistivity and dielectric strength, and (4) sealing property as a gasket material.

What Type Flange?

The type of flange which is selected depends on operating conditions and individual preferences. The types which are most easily insulated, such as the raised face and ring joint, should be used wherever possible. The use of preinsulated couplings and unions should be considered in lieu of flanges. A complete discussion of materials and type of connector is outside the scope of this paper, since it is intended to answer questions with regard to the use of insulation and not the selection of it.

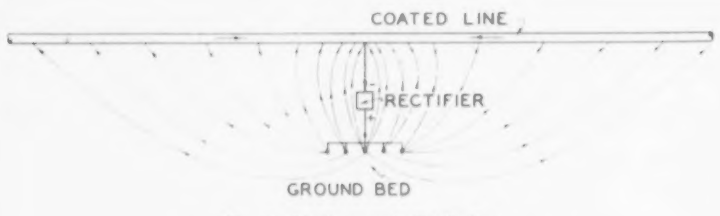

Fig. 1—Ideal current distribution.

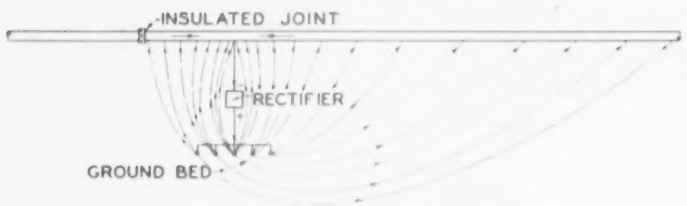

Fig. 2—Current distribution with insulation.

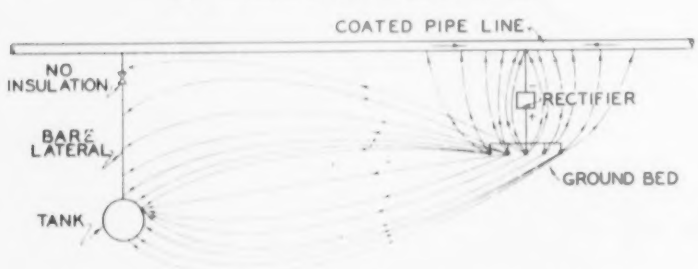

Fig. 3—Current distribution after connecting tank and lateral.

Why Insulate?

Insulation is installed in pipe-line flanges in an effort to segregate electrically two sections of pipe. Although this electrical segregation requires additional material, labor, and patience, it is readily justified. Failure to insulate, improper installations, and poor maintenance of insulated flanges are problems encountered in most pipe-line systems. The solution of these problems is the task of the corrosion engineer, but the close cooperation of design, construction, operative, and maintenance personnel is required.

Economics . . . A proposal for cathodic protection to be applied to a pipe-line system must be suited for economic justification in the same manner as any other contemplated investment. This justification is either present or absent after considering such factors as: (1) the original cost of the pipe line; (2) its life expectancy; (3) the importance of uninterrupted service, and (4) the cost of the proposed protection. After considering these factors, a decision is often made to protect a portion of a system and leave other portions unprotected. This decision then obligates the corrosion engineer to use insulation to segregate the protected lines from the unprotected ones.

How the Insulated Flange Works

A comparison of Figs. 1, 2, and 3 discloses the effect of the insulated flange on the control of current flow to a pipe line. Fig. 1 depicts an ideal distribution, Fig. 2 gives the distribution caused by the blocking effect of the insulation, Fig. 3 shows how the current distribution from the rectifier ground bed is distorted when a bare lateral and tank are tied directly into a protected line, such as that illustrated in Fig. 1. The ideal current distribution is distorted because of the tendency of the lateral and tank to rob the coated line of its protection. (Rectifiers are shown as the source of protection for all illustrations. This is only for ease in presentation. The ideas are the same for protection supplied by sacrificial anodes.)

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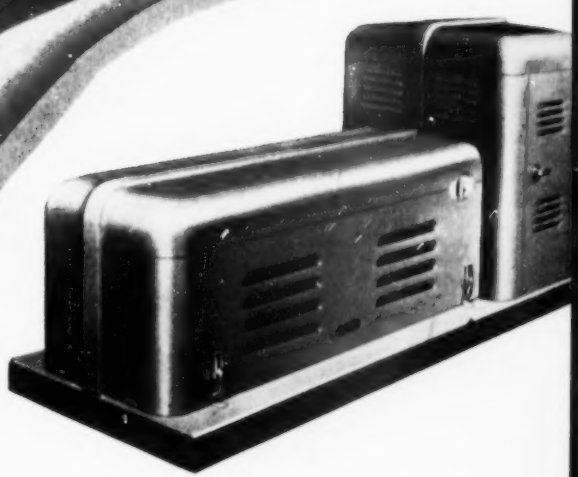

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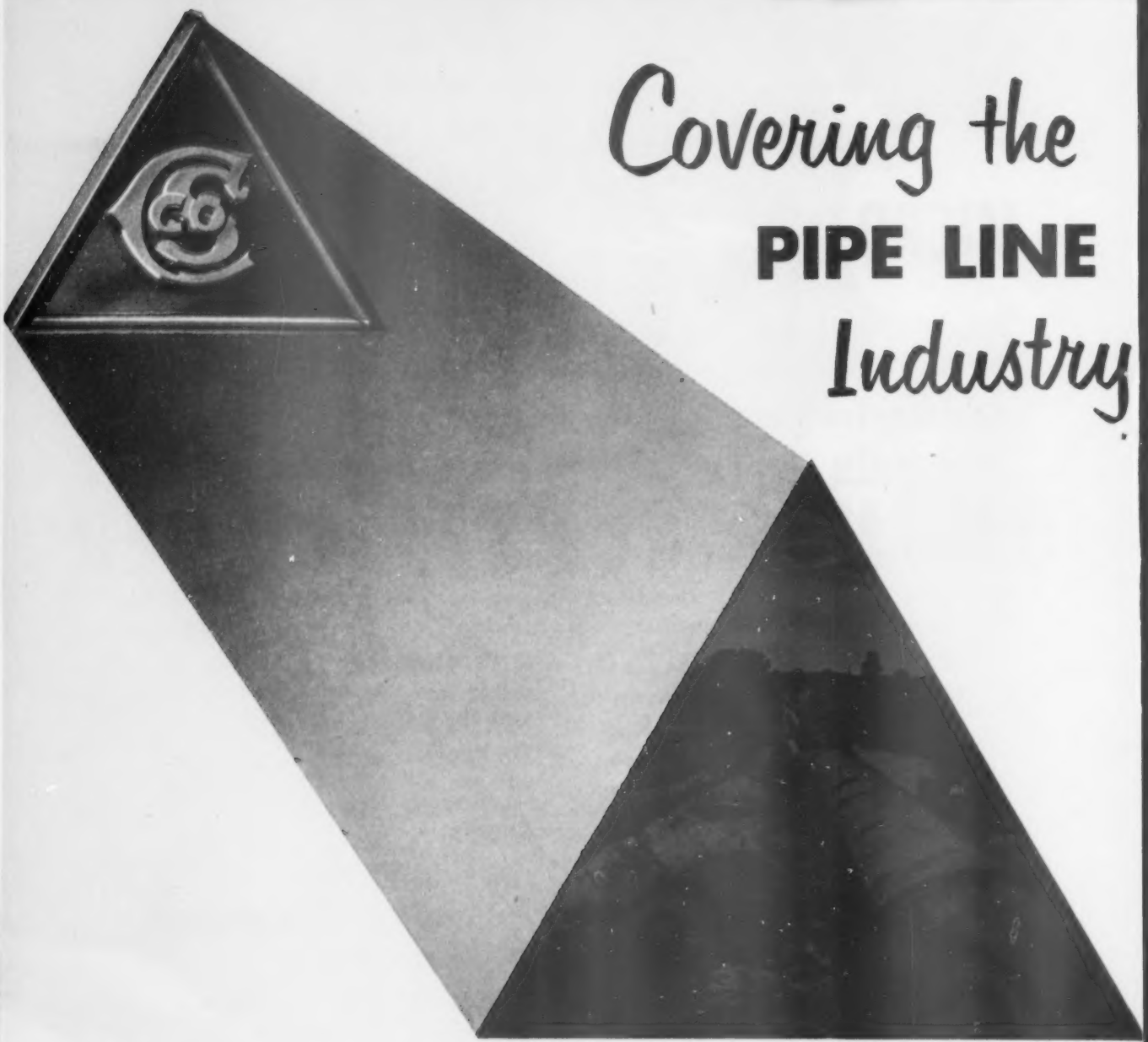

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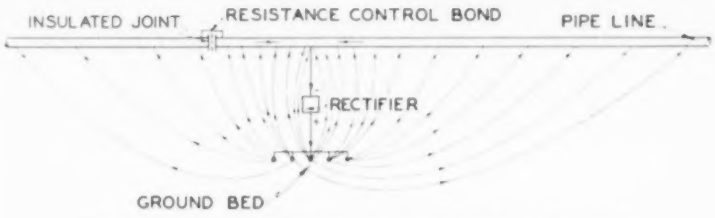

Fig. 4—Current distribution with resistance bond and insulation.

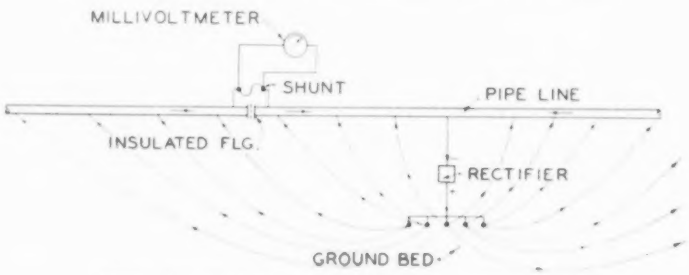

Fig. 5—Use of shunt and insulation to measure line current.

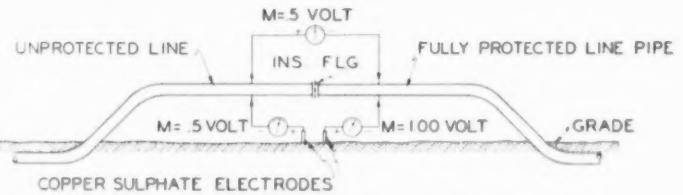

Fig. 6—Typical cathodic-protection potentials, Case 1.

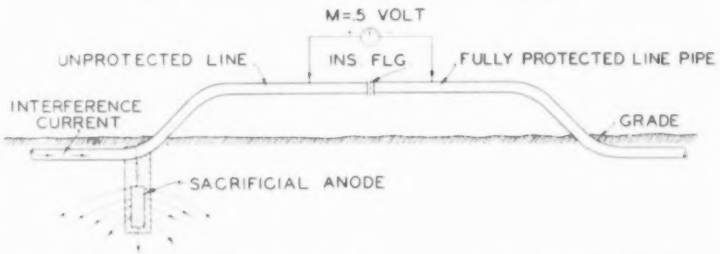

Fig. 7—Method of eliminating corrosion due to high potential across an insulated flange.

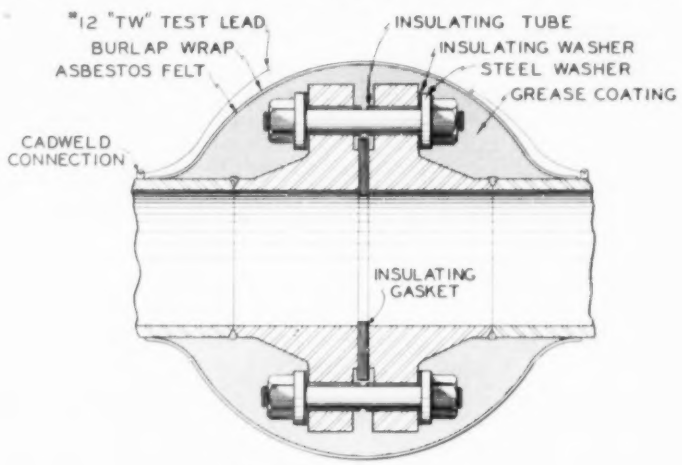

Fig. 8—Typical insulated flange.

insulated flange is evident if it be assumed that a decision has been reached to protect the main line, and to leave the lateral and tank unprotected because they represent a smaller investment and are intended for temporary service. With no insulation, the lateral and tank are not unprotected but actually may be overprotected, whereas the main line is receiving only a slight amount of the current intended for it, resulting in its underprotection. The corrosion engineer can select from alternatives. First, he can buy a larger rectifier and install more ground bed to force complete protection on the main line while adding more current to the already overprotected lateral and tank, but this alternative is not in accordance with the decision to protect the main line only. Second, he can resort to the method shown by Fig. 2 and stop the current flow with an insulated flange at the tiein.

The second alternative is not only the logical one; it is dictated by its low cost compared to that of the first choice.

More on Economics

There is another example that may be used to prove that insulation is dictated by economics. Fig. 1 shows a line with no insulation; all parts of it receive a uniform amount of protective current. It is conceivable that a corrosion survey has shown that the right portion of this line needs considerably more protection than the left, and that it is not possible to move the rectifier and ground bed any closer to the corrosive area on the right.

The problem is to shift the symmetrical output of the rectifier so that practically all of its output will flow to the corrosive section of pipe. This problem is very easily solved by use of a resistance bypass around an insulated flange. The resistance of the bypass can be adjusted to give any division of current desired. Fig. 4 illustrates how the current can be crowded to the right by use of a resistance bypass. Again, a saving is evident because currents that

THE AUTHOR

Thomas M. Ragland is corrosion engineer for Phillips Petroleum Co., Bartlesville, Okla. His work includes corrosion surveys, design and test of cathodic-protective systems, and pipe-coating conductance tests. Ragland holds a bachelor of science degree from University of Kentucky, and has worked for Phillips since his graduation. He has been active in corrosion control the entire time except for a short initial assignment in electrical design.

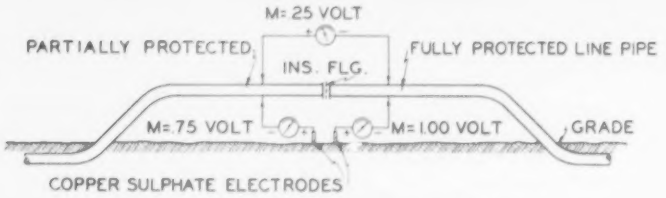

Fig. 9—Typical cathodic-protection potentials, Case 2.

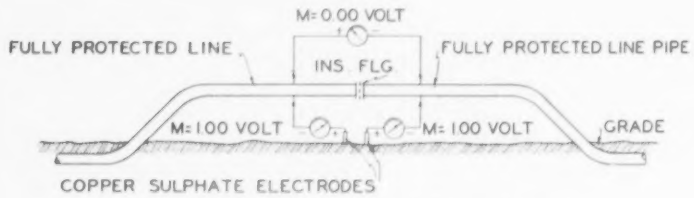

Fig. 10—Typical cathodic-protection potentials, Case 3.

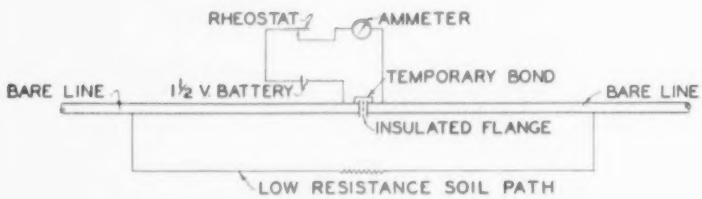

Fig. 11—Schematic of battery test for insulated flanges.

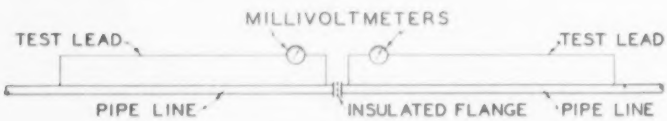

Fig. 12—Line current test of insulated flanges.

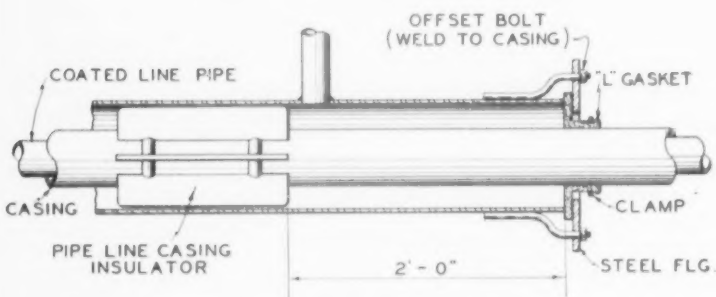

Fig. 13—Details of casing insulation and seal, Case 1.

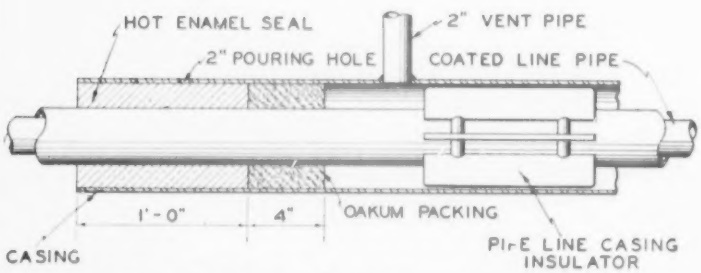

Fig. 14—Details of casing insulation and seal, Case 2.

were being wasted on the left have been directed to the right where they are actually needed.

Another reason for installing insulated flanges is their value in conjunction with testing and adjusting cathodic protective systems. For example, the measurement of the current flow in a pipe line, either protective or destructive, is rather complicated. The insulated flange can be used to obtain a quick and accurate measurement of the current flowing in a pipe line. Fig. 5 presents such a method. The insulation forces all the current through the shunt to give an almost exact reading of its magnitude. After the reading is taken the low-resistance bond may, if necessary, be reconnected to short out the insulation. (If extreme accuracy is desired a zero resistance-type ammeter should be used instead of a shunt and voltmeter.)

The resistance bypass has been mentioned in connection with economic reasons, but even apart from economic reasons, the resistance bond around an insulated flange is one of the most versatile tools of the corrosion engineer. Cathodic protective systems seldom perform exactly according to the wishes and desires of the designer, because of the difficulty in obtaining complete design data. However, their performance may often be improved by the use of resistance bypasses.

Stray Currents

In industrial areas, and to some extent in other areas, currents of varying magnitude and direction are often present on pipe lines. These are called stray currents, because they originate from sources apart from the pipe-line system. The location of the pickup and return point of stray currents can be an almost endless task. It is known that their discharge from the line direct to soil will be destructive; therefore, a method of controlling them is imperative. One method of control is to break the line into relatively short sections with insulation at the section ends. This tends to eliminate the harmful effects of stray currents or at least confine them to the short sections where they are easier to control.

Where to Insulate?

The second major question regarding insulated flanges is: Where should insulated flanges be installed? It is impossible to give a definite guide stating exactly where insulation is needed, but as a general rule the insulated flange should be used liberally. A liberal use of insulated flanges is suggested because bonding the insulation with the line in operation is a simple matter, whereas installing insulation, especially

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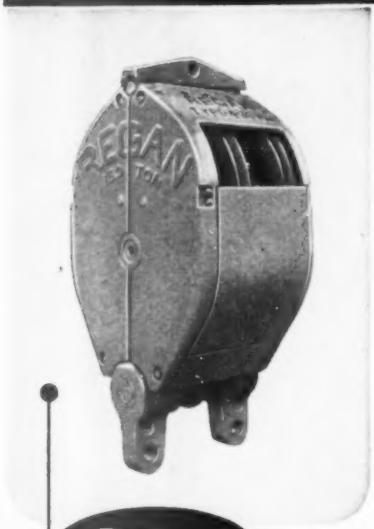

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the gasket, when the line is operating is often difficult.

What to look for . . . A liberal use of insulated flanges is desirable, but in no case should insulation be installed or removed without serious consideration of the consequences. For example, highly protected lines are usually insulated from lines which have little or no protection, but consideration of the typical potentials given by Fig. 6 will prove that a rigid adherence to this practice is an invitation to trouble. A rigorous electrical analysis of Fig. 6 is not necessary, but the end results are that the protected line tends to drag current along the unprotected line until it hits the high resistance of the insulation. Since the current cannot pass through the insulation, it will find another path to the protected (negative) side of the flange. The current will leave the unprotected pipe, use the soil to bypass the insulation, and then return to the highly protected pipe. Corrosion will occur where the current leaves the unprotected pipe to use the soil in bypassing the insulation.

This corrosion trouble may be corrected by use of a sacrificial anode as a drainage point on the positive side of the flange as illustrated in Fig. 7. If this is not feasible, a resistance bond may be used to give the current a path other than the soil. The selection of either the anode or resistance bond would probably be the responsibility of corrosion control personnel.

Keeping records . . . The decisions of where to insulate are often so obvious that it is not necessary to consult a corrosion engineer before installing or removing insulation; however, in all cases he should be informed of the action taken. Keeping the corrosion control section informed of what is done is necessary for two reasons: (1) there may be a condition existing which is not so obvious; and (2) records must be kept in order that future tests or changes may be planned according to existing conditions. The corrosion-control section has the responsibility of making the final decision about where insulation is to installed: usually insulation will be specified where new piping is tied into old piping, where bare lines are tied into coated lines, where lines come into and leave a pump station or plant, and where the block gates occur on each side of a river crossing. Aboveground insulation flanges are most desirable, and insulation in pits or gate boxes is to be preferred to direct burial.

Spark hazard . . . Another point which cannot be omitted in enumerating the places to install insulation is that it must be installed wherever the safety engineer specifies to eliminate a spark hazard from the protective voltages. An arc can be expected when a line carrying currents back to the negative side of the rectifier is cut or broken. Arcing can be prevented by using insulated flanges to keep the current from the piping that is being worked on. However, flanges must be located and properly protected so that there will be no sparking hazard if, for example, a wrench is dropped across one which has a high potential across it.

How to Insulate

A suggested method for insulating flanges is shown in Fig. 8. The insulation on each end of the bolt is not necessary but it greatly facilitates testing a faulty flange. Each bolt, except the faulty ones, is completely segregated from the pipe and they may be quickly located with an ohmmeter or battery. While coating and wrapping is usually omitted for aboveground installations, it should by all means be used on underground flanges; further, the pipe should be coated and wrapped a minimum of 25 ft. each side of the flange. Patented flange covers may be used instead of the coating and wrapping. Test leads are not needed for aboveground installations but should always be installed on buried flanges.

Precautions . . . The most important of these are:

1. Inspect the flange faces for burrs or bits of grit that might penetrate the insulating gasket and thus short it out or, at least, make sealing difficult.
2. Use every effort to have the holes aligned so that the spools will slip over the bolts without forcing. Some form of reamer may be needed on existing flanges. The use of dowels to align the holes before the flange is welded in place will usually assure proper alignment of new flanges.
3. In making up the bolts use every precaution to snub them properly to prevent their turning and cutting through the thin spools.
4. Fit insulating washers snugly over and flush with the end of the spools.

Testing Insulation

Once the flange is insulated, the remaining problem is a test to determine that the insulation is not damaged or shorted. At the present time, there seems to be no test that is simple and completely reliable in all cases. The reason for this is the complications that are thrown into the test by the soil path which shunts or bypasses the insulation. This path appears as a resistance leak across the insulation and may be any magnitude from a fraction of an ohm resistance, if the pipe line is bare, up to hundreds of ohms on a short section of well-coated line.

One test which is relatively simple to make, if the proper instruments are available, is shown by Fig. 6. One meter reads the potential across the flange while the other two double-deck it by taking potentials to soil each side of the flange. (In practice, only two meters—or a combination meter—and one electrode would be used. Two high-resistance voltmeters, or potentiometers, for soil potentials and one low-resistance meter for the potential across the flange are illustrated to show that the sum of the voltage drops around a closed circuit is zero.) The difference in soil potentials will very nearly equal the potential across the flange.

Fig. 9 illustrates the same method with the conditions of protection changed, while Fig. 10 shows an insulated flange with each side fully protected. In the case of Fig. 10, the potential across the flange is zero but this does not mean the insulation is shorted, although it would not matter if it were.

An alternate test which has many variations consists of putting a battery across a flange to test its insulation. Its simplest form is to watch for sparking when the battery is connected directly across the flange. For a well-coated line a spark would indicate that the flange is shorted. Lines with poor coating or bare lines would have a low contact resistance to soil and a spark can be made by the current flowing through the soil path.

Use of battery . . . This method may be modified by using an ammeter or light in series with it. Fig. 11 is a schematic diagram of such a setup. With the flange temporarily shorted, the rheostat is adjusted until the meter reads approximately three-fourths full scale. The removal of the short should cause a substantial drop in the meter reading because the current path is now through the soil rather than through the short around the effectively insulated flange. In some cases the meter may pick up when the short is removed because the normal potential across the flange adds to the battery voltage. A light bulb could be used in place of the meter and the indication would be a drop or gain in its intensity.

Pocket compass . . . Use of a cheap pocket compass in conjunction with a battery is proving to be a very satisfactory test of insulated flanges. This test is made by placing the compass on the pipe a few feet from the flange with the battery connections still farther away on each side of the flange. When the battery circuit is closed, the compass needle will move provided there is a low-resistance leak in the insula-

tion. Otherwise, the battery current must take the soil path and by taking it the magnetic field of the compass needle will not be disturbed, leaving the needle in its assumed position.

If none of the above tests is conclusive, voltage drops may be taken each side of the flange, as indicated by Fig. 12, and their magnitudes and directions compared to ascertain if there is a current flow through the flange. Any test which indicates a flange to be shorted or insulated is more reliable if the flange is positively shorted sometime during the test to substantiate the indication further.

Casing Insulation

Highway departments and railroad companies have different specifications for pipe-line crossings, and the boring and pulling of the crossing are construction problems. Therefore, there is no need to elaborate on them in connection with casing insulation, but it should be remembered that it would certainly be difficult to pull a coated casing and retain coating on the outside surface. Consequently, the casing is usually not coated, and if the pipe line which passes through it is firmly bonded to the casing in one or more spots, then for all practical purposes cathodic protective currents will be stolen from the pipe by the entire length of bare casing. The casing does not rob the length of pipe which is inside of it, because it shields this section of pipe from the cathodic protective currents. However, the pipe each side of the casing is robbed of its protection.

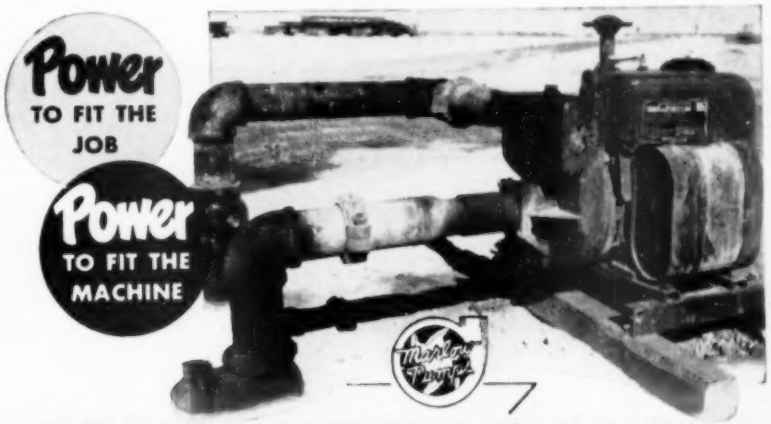
To prevent the casing from taking the pipe's protection, every effort must be made to keep the two separated by some form of insulation. This effort is necessary because current flowing to the casing is wasted insofar as pipe protection is concerned, and because insulation between the two serves to protect the pipe's coating during the pulling operation.

Since there can be no protective currents applied to a cased pipe, because of the shielding by the casing, it is imperative to get the pipe pulled with a minimum of damage to the coating. Figs. 13 and 14 show two different types of seals for keeping water and rodents out of the casing, and one method of using insulators to space the pipe in the casing. There are variations of these methods which are equally satisfactory for protecting the coating and separating the pipe from the casing. Any method which achieves these two conditions will be justified by the decreased expense on, and the improved permormance of, the protective system.

There has been phenomenal progress in corrosion mitigation. This is certain to continue because of the lower maintenance costs and improved operations now apparent in protected pipe-line systems. As the work of cathodic protection continues to spread throughout the oil industry, the use of insulation must be given more consideration. A sound engineering approach will be needed, but, as in any engineering problem, the approach must be made with an understanding of the fundamentals. Only a few fundamentals have been presented here. They have been offered in explanation of the need and function of pipe-line insulation. They are not intended as a guide for an engineering study of an insulation program.

More Customers for Gas

In the postwar period the number of commercial gas customers in the United States rose at a faster rate than retail business establishments. Volume of commercial gas sales has nearly tripled since 1941. Much of this utility gas growth was in the food service field, which has become the nation's fourth largest industry.



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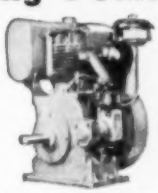
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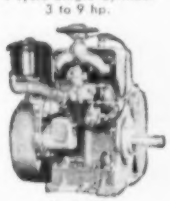
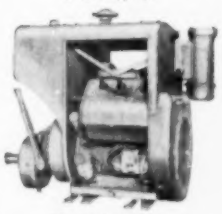

2-cylinder
7 to 14½ hp.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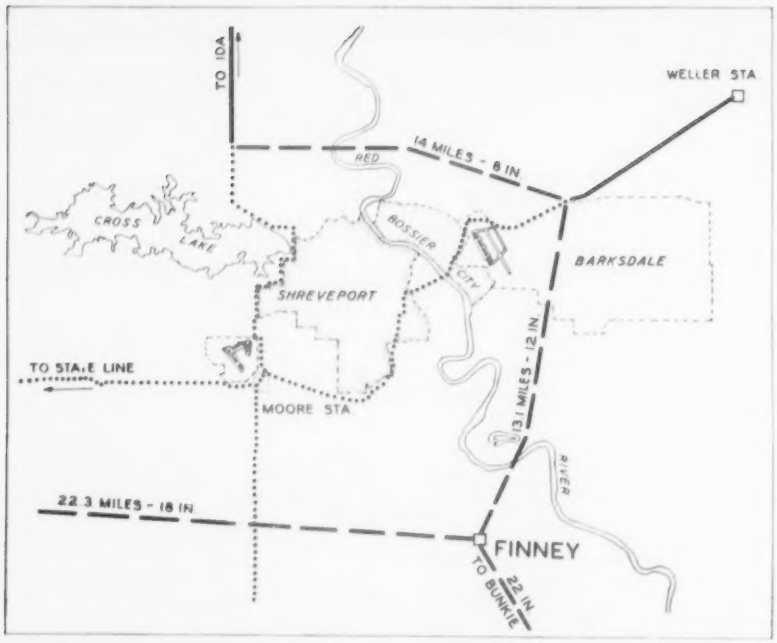


Map shows rerouting of lines in Shreveport area and location of new Finney station in the Interstate Oil Pipe Line Co. current modernization program. New lines going to Finney station are shown (dashed) and old lines to Moore station which have been pulled up (dotted).

Interstate's Finney Station Will Serve as Receiving Point

Jersey Standard's W. R. Finney honored in naming new station

by E. C. Mishou

WORK is in progress on a new crude-oil pumping station for Interstate Oil Pipe Line Co. on Ellebre Road about 8 miles south of Shreveport. As a token of appreciation to Wallace R. Finney, retired pipe-line advisor, Standard Oil (N.J.), the station, a part of Interstate's modernization program, will be called Finney station. The station will serve as a receiving point for Texas crudes, and accumulation point for North Louisiana-Arkansas crudes consigned to Baton Rouge. The various grades will be segregated and pumped in batches out of Finney.

Extensive Modernization

Interstate's modernization program consists of a replacement of 620 miles of 8 to 12-in. pipe with 222 miles of 8 to 22-in. pipe from the Shreveport area to Baton Rouge, rerouting to avoid urban areas and shortening the length of haul. Six main-line pumping stations with 77 pumping units rated at 13,300 hp. are being replaced by two stations with six units rated at 8,100 hp. The new system will have a design capacity of 133,000 bbl. per day, which is 26,000 bbl. per day above the operating capacity of the system replaced. Provision has been made in the selection of pipe size and pumping equipment at Finney for a future increase of 24,000 bbl. per day. The station at Bunkie, La., was completed in 1952 and work is in progress on the pipe-line replacements.

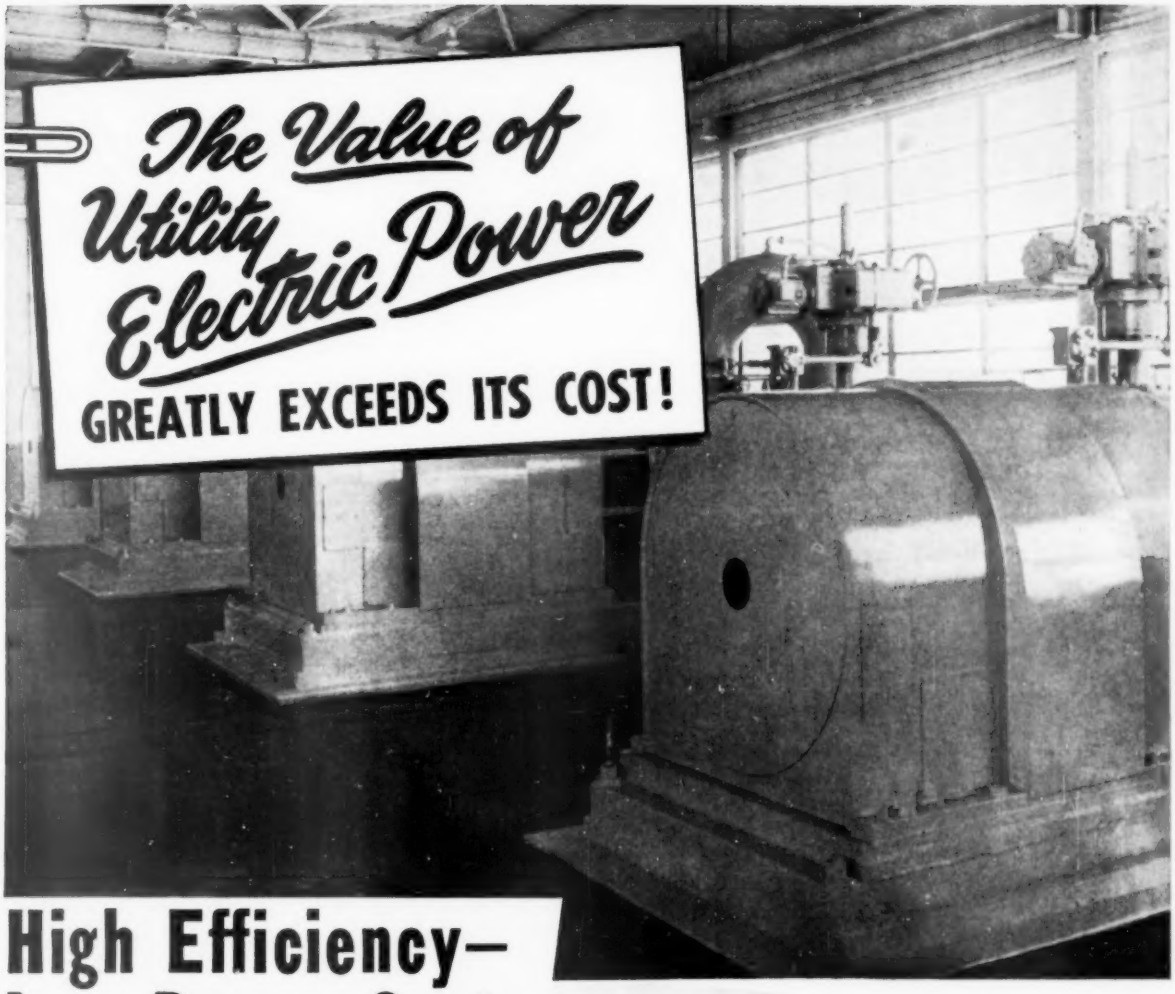
The sketch map (Fig. 1) shows the station location and the rerouted lines in the Shreveport area. In the preliminary selection of the station site, consideration was given to the determination of the location which would result in minimum investment for pipe lines. After this point was located, the nearest practical site which was available was secured.

Finney pumping equipment . . . This will consist of three 1,500-hp. motor-driven centrifugal pumping units and two 100-hp. motor-driven booster pumps. Under average conditions, this represents one spare main unit and one spare booster unit. The motors are weather protected, self-ventilated, and designed for operation outdoors without additional protection from the weather. The main pumps are two-stage horizontal split case 10 by 12 centrifugal pumps. The booster pumps are 12 by 14 horizontal single-stage centrifugal pumps. An electric heater is installed in each motor case, which will automatically be energized when the motor is off the line. The purpose of the heater is to prevent moisture condensation inside the motor.

Power at this location will be purchased from the local public-utility company at its substation on the site. The design of the electrical equipment and control devices to be installed follows generally the pattern set by the industry over the past few years. The electrical equipment, in addition to the motors, consists of indoor metal-clad switchgear, a station control desk, an indoor control center, and an outdoor control center. The metal-clad switchgear contains the motor starting breakers, relays, and various auxiliary devices, incorporated into the control scheme. The station control console assembly consists of two plastic-top control desks, with a working desk between, and with a rear vertical gage panel. One desk will have a diagram of incoming lines, manifold, and tank-farm piping with push buttons and indicating lights to control the operation of valves and equipment in the manifold and at the tanks. The other desk will have a diagram of the main and booster unit piping and outgoing scraper trap, with similar push-button controls and indicating lights. Incoming and outgoing scraper-trap valves are controlled by push buttons at the traps only. The indoor and outdoor control centers contain the contactors and relays necessary for the motor-operated valves and tank agitators.

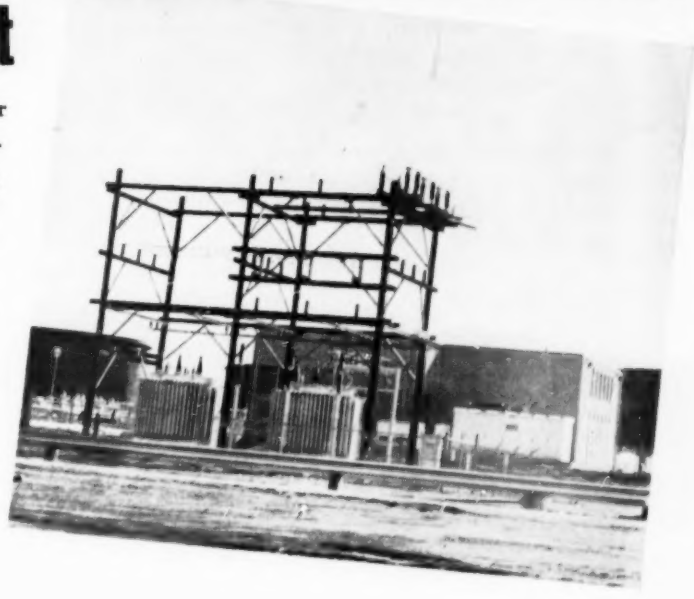
Starters . . . For the main and booster motors, the starters are air circuit breakers electrically closed by rectified a.c. and tripped by d.c. from a 48-volt battery. Each main motor is provided with time delay undervoltage protection, also short circuit, locked rotor, single phase, and thermal overload protection. A temperature relay actuated by exploring coils will warn the operator in the event of over-temperature in the windings. A temperature indicator with transfer switches is provided whereby motor-winding temperatures at each sensing point can be selectively indicated.

The control system for each main



High Efficiency—Low Power Cost

Utility electric service was chosen to power this modern pipe line station, because experience indicates that maximum operating efficiency and lower cost result from use of modern electric utility service. Automatic controls, together with safety and protective devices, effect substantial savings in operating labor. Much lower initial investment, together with correspondingly lower fixed charges, dependability of power supply, and lower maintenance are a few of the other advantages enjoyed by users of utility electric service in pipe line operation.



TEXAS ELECTRIC SERVICE COMPANY

pump unit combines the motor starting gear with controls for pump suction, discharge, and pump venting valves and also with the protective pressure and temperature relays. The system is so designed that when the operator pushes the start button on the control desk the following operations occur, in sequence:

1. Motor operated pump suction valve begins to open and
2. Vent valve on pump casing opens to the station sump.
3. With the pump suction valve fully open, the motor starts. When this occurs
4. The motor-operated pump discharge valve opens, and
5. The pump casing vent valve closes.
6. The sequence is checked and if completed within the prescribed time, the unit remains in operation; otherwise it is stopped.
7. With the unit in operation, any deviation of the suction or discharge valve from full open will shut the unit down.

To stop the unit, the operator pushes the stop button and

1. Motor circuit breaker opens to stop the pump.
2. The pump suction valve closes, and simultaneously
3. The pump discharge valve closes.

Conditions which will shut down the unit as a protective measure include high temperatures in motor and pump bearings, overcurrent to motor, pump-case temperature, and pump mechanical-seal failure. Any of these conditions, and also a resumption of service after power failure, will actuate the shutdown sequence.

Booster pump control . . . For normal operation this is very similar to the main pump control, combining the pump motor starter with the suction and discharge valve controllers. Control is simplified by reduction of the protective devices to time delay undervoltage, phase unbalance, thermal overload, overcurrent, and pump mechanical seal failure. Before the normal starting sequence can take place, at least one of the tank suction valves must be open.

Other protection . . . The main units are also protected by a low-suction-pressure switch with sensing element between the booster and main pumps. The main pumps cannot be started with insufficient suction pressure and will shut down if the suction pressure in operation drops to a predetermined level. A similar switch with a slightly different setting will provide an alarm prior to shutdown. A similar device on the discharge side of the station will cause a shutdown and indication if the discharge pressure exceeds the allowable amount.

One of the booster pumps is to be set up to provide a transfer pump to move oil between the oil tanks. This provision is made so that blending of the

THE AUTHOR

E. C. Mishou, chief engineer, Interstate Oil Pipe Line Co., began his pipe-line career as an engineer with Ajax Pipe Line Corp. in 1943.

In 1945 he transferred to Interstate as safety engineer, with headquarters in Tulsa. In mid-1947, he was made assistant division chief engineer of Interstate's Southern Division, with headquarters in Shreveport. He was promoted to division chief engineer in October 1948. In May 1952, Mishou left Interstate to accept a special assignment in the office of the pipe-line advisor of Standard Oil Co. (N. J.) in New York. He remained on this special assignment until he returned to Interstate as chief engineer at the beginning of 1952.

Born in Pueblo, Colo., Mishou attended Columbia University, and later received his B.S. degree in petroleum engineering from University of Kansas.

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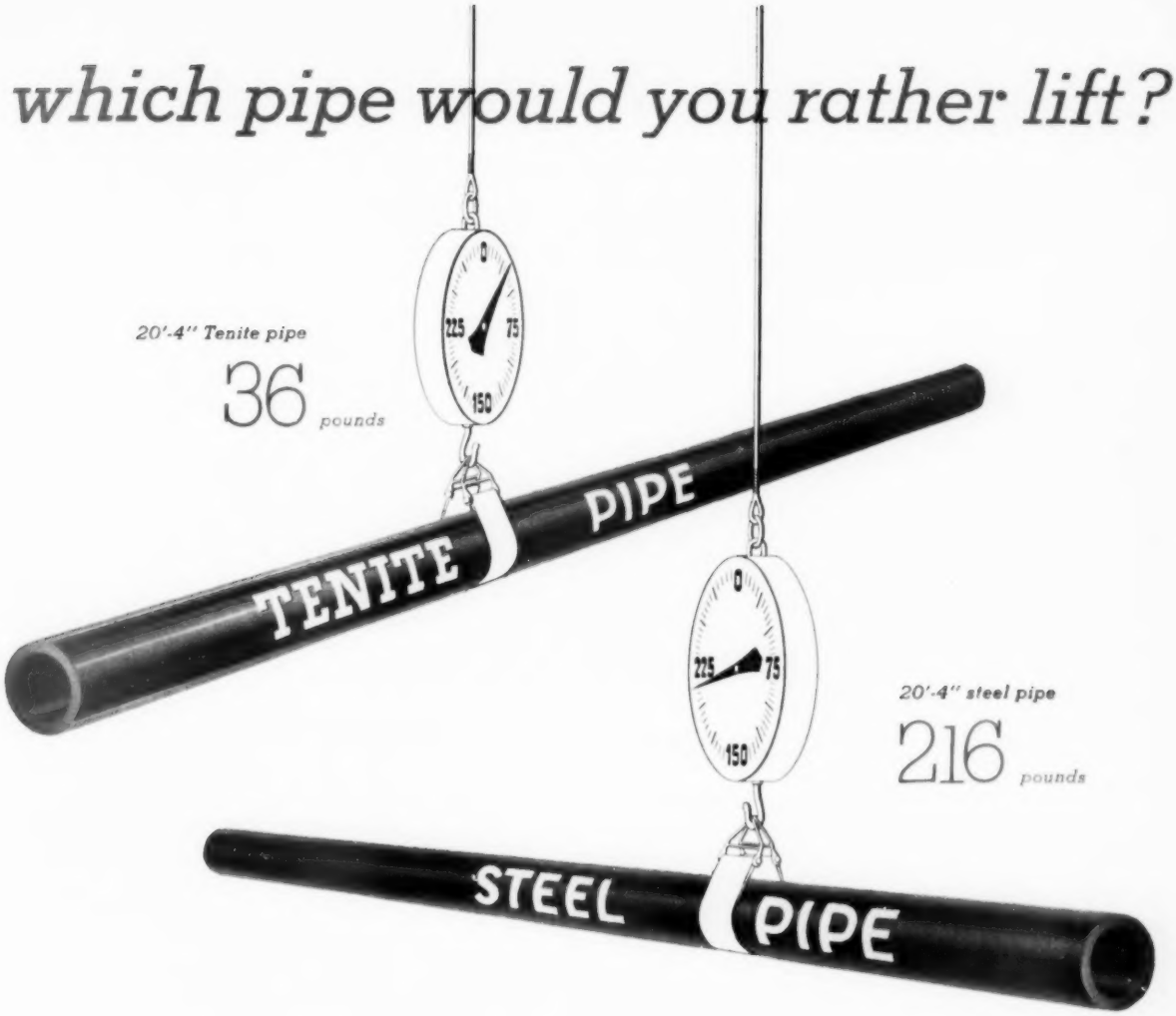

OIL men are big strong fellows . . . but regardless of how big or how strong they are . . . they all tell us that lightweight Tenite pipe is wonderful to handle.

Tenite pipe makes possible considerable savings in installation costs. For example, in a typical case, three men laid 4,000 feet of 4" Tenite pipe in a day; eight men are usually required to lay the same amount of steel pipe. *This meant a clear savings of 62% in labor costs.*

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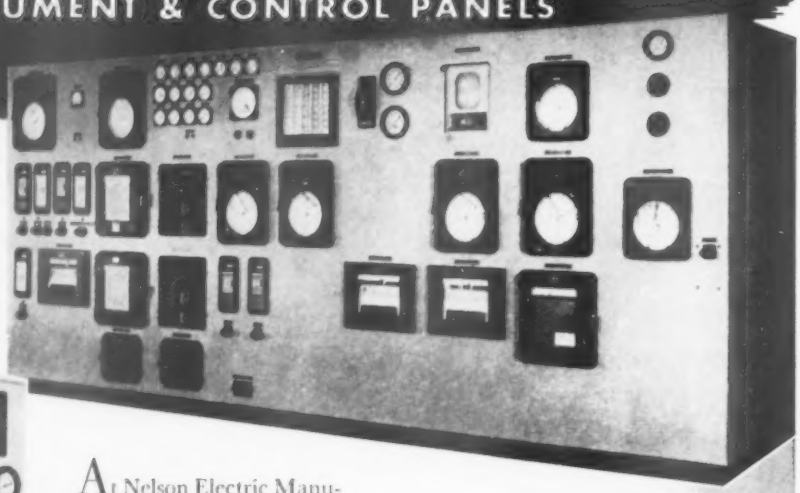
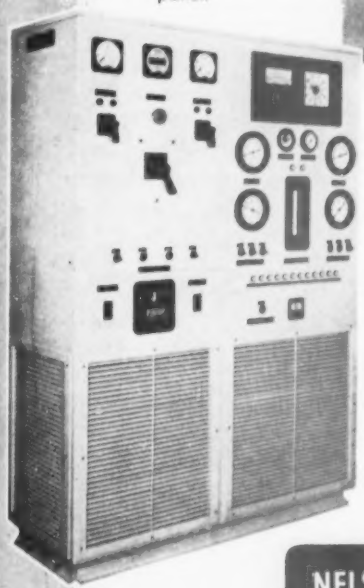
CUSTOM-BUILT
INSTRUMENT & CONTROL PANELS



▶ Piped and wired instrument and control panel for power plant.

▼ Engine control panel.



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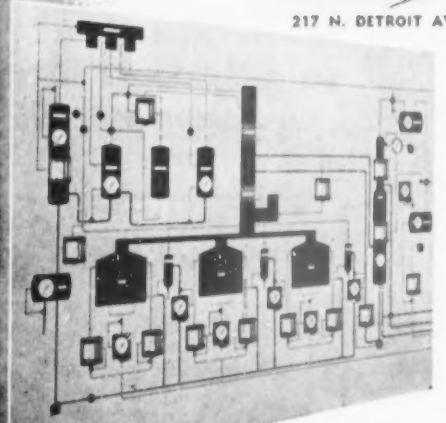
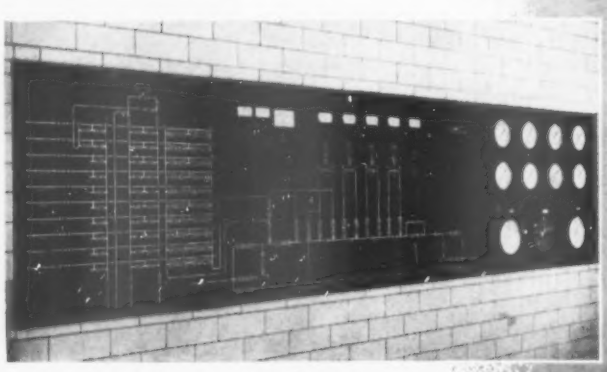
▲ Pressurized piped and wired cubicle for kiln control.



▲ Graphic instrument panel with multi-colored flow lines.



▲ Control panel installed in products pipe line station.

crudes can be accomplished to the shipper's requirements.

Traps, Lines, and Tanks

Two incoming lines extend to the manifold and through motor-operated valves are connected to each of the nine tank lines. The third and fourth lines on the raised portion of the manifold are connected to the booster pump header for the transfer-line service. A truck-unloading rack at the station also discharges into the manifold through one of the lines. The fifth elevated line with connection to selected tank lines provides a relief line from the incoming lines at the scraper trap area. Through this arrangement, incoming crude can be directed into any of the nine tanks set out for that particular grade of crude.

Tank lines . . . In operation suction will be taken from any required tank into the header immediately in front of the manifold area. The suction valves on the tank lines at this location are those tied in with the sequential control of the booster pumps. One additional tank line is to be installed in the manifold for future requirements.

To the left of the manifold area are the booster pumps, arranged in parallel. Strainers to protect the booster and main pumps are installed in each of the parallel runs, and a hoist is provided to lift the strainer baskets for cleaning.

From the booster-pump area, the piping extends to the main pumps connected for series operation. At each pump is the rack containing switches for the pump and motor protection.

The outgoing scraper trap is in the background. One item of interest is that a hydraulic operator is to be installed on one of these valves. All other valves at the station required for normal operations will be motor operated.

Tanks . . . The nine working tanks to be installed will have a combined capacity of 815,000 bbl. Double-deck floating roofs were selected and motor-driven propellor-type agitators will be installed to retard the settling of "crude bottoms" as well as aid in blending when necessary. The tanks are installed on concrete-ring wall foundations and on compacted fill. Firewalls will be provided for each separate tank with a capacity in excess of tank capacity. Fluid levels in the tanks will be transmitted to the operator's desk by remote-reading, double selsyn-type tank gages.

Office and control building . . . This will be constructed of concrete blocks with buff brick veneer. It will house the operator's office with the station control desk overlooking the pump and manifold area. A gager's office and sample and testing room is also provided with separate entrances. The switchgear and indoor control center will be located in back of the operator's office and warehouse space is being provided in building wing off the gager's office. An office for the station chief engineer is provided at the front of the building. Building materials have been selected with an eye to low maintenance costs. Window frames and door frames will be of aluminum to eliminate painting. The inner side of the concrete building blocks will be prefinished and will serve as interior finish. The partitions, also of concrete block, will have all exposed surfaces prefinished. Recessed fluorescent lighting has been selected and the work areas will be air conditioned by means of an air-to-air heat pump. The building will be of fire-resistant construction and is classed as nonhazardous with respect to explosionproof electric fixtures, with the exception of the sample room. Strain-gage-type gages are being used for the suction and discharge pressure indicators and recorders, and as the building is separated from the pumping equipment, the hazard of accumulations of flammable vapors is at a minimum.

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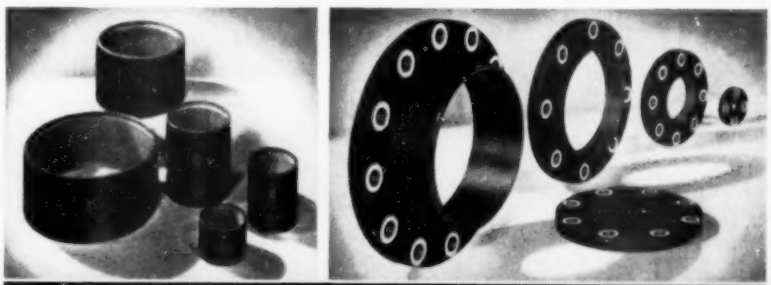

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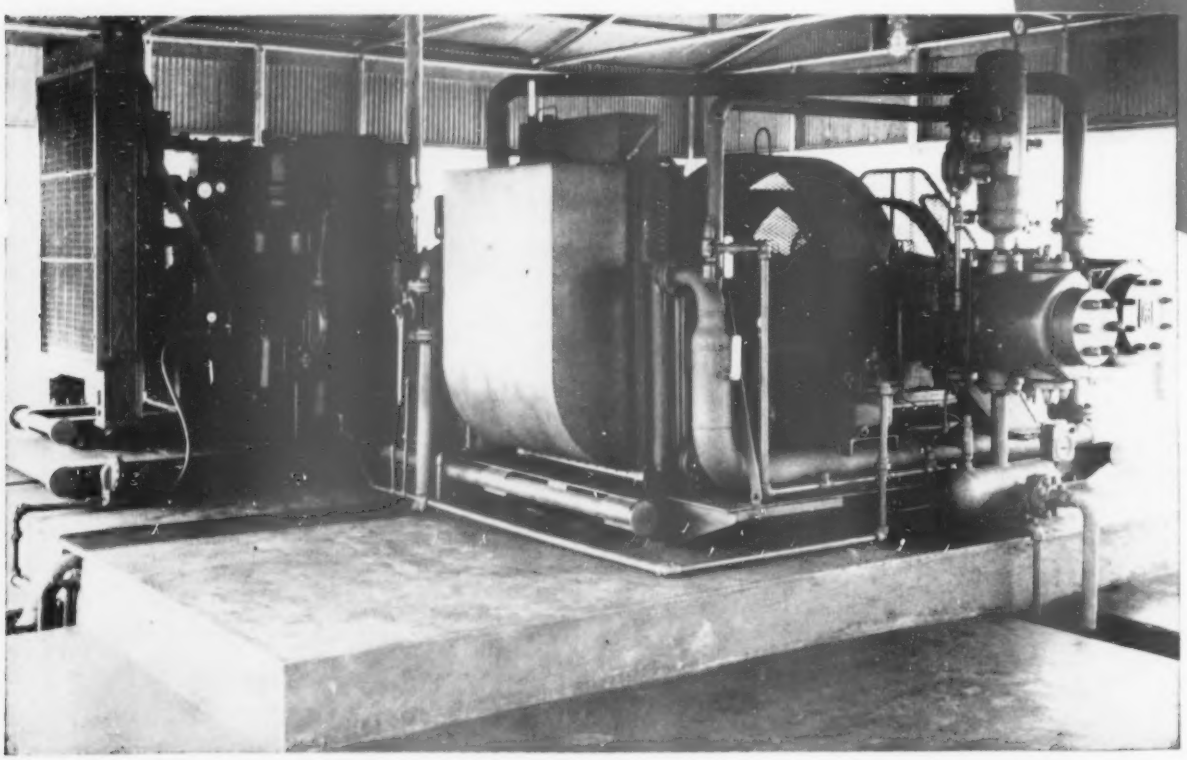

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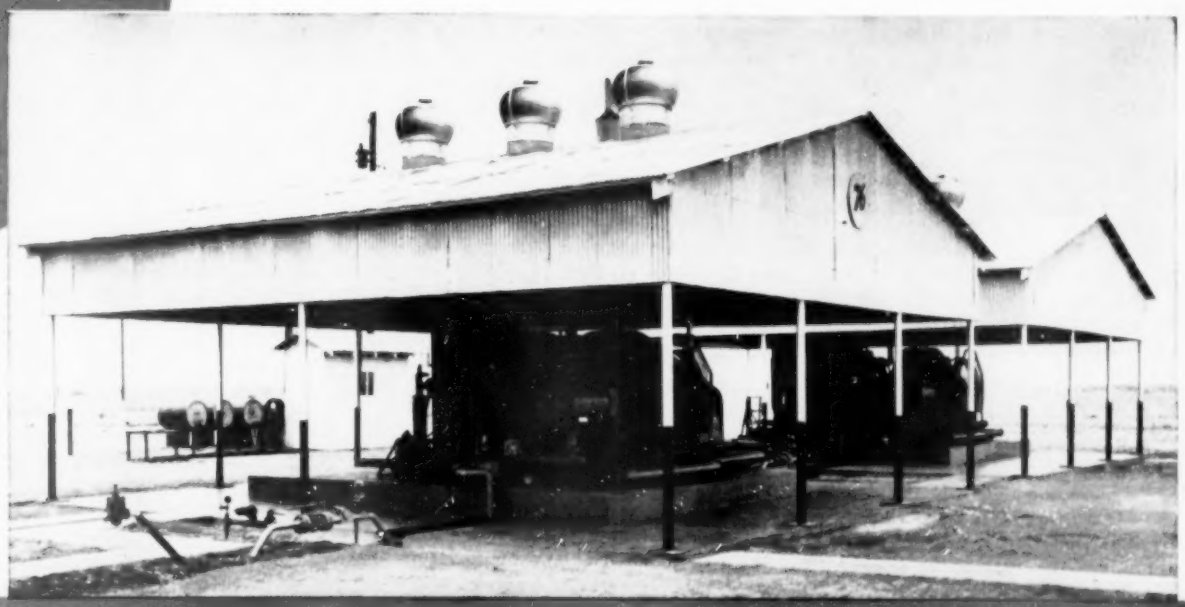

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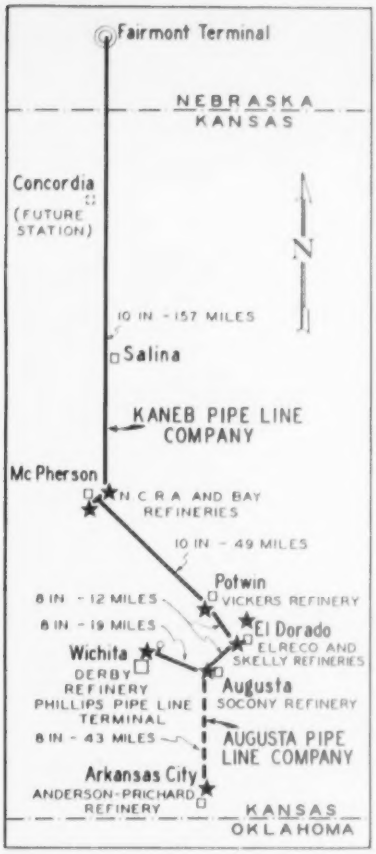

Fig. 1—Route of Kaneb and Augusta pipe lines.

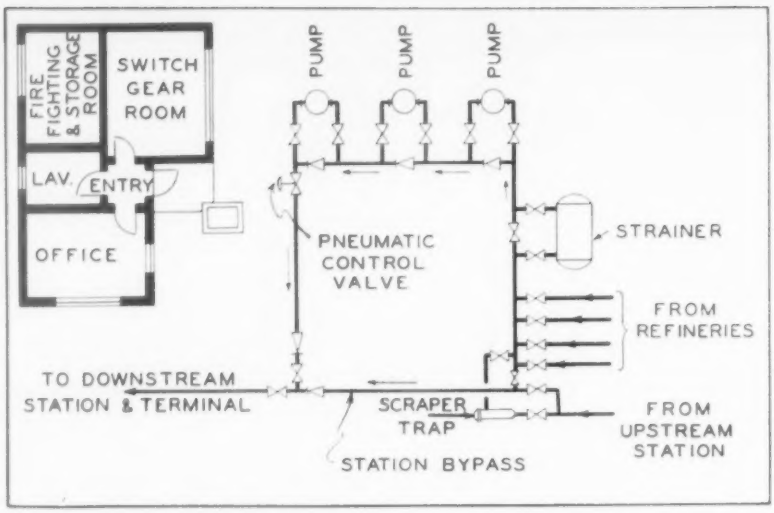

Fig. 2—Typical pump station on Kaneb and Augusta pipe lines.

Modern Design Features New Kaneb and Augusta Lines

Refineries will have outlets to natural market areas

by Frank E. Hangs

THE system composed of Kaneb Pipe Line Co. and Augusta Pipe Line Co., has been designed for an initial throughput of 25,000 bbl. of products per day. These pipe lines will provide land-locked refineries in South Central Kansas with an outlet to a natural market area centering in southern Nebraska. Market surveys indicate that the proposed tariffs will result in substantial transportation savings to the shippers.

Products to be handled include premium gasoline, house-brand gasoline, third-grade motor gasoline, tractor fuel, kerosine, and No. 1 burner oil. It is probable that diesel fuel or some similar product will also be handled, depending upon the requirement of the shippers.

Kaneb Pipe Line Co. and Augusta Pipe Line Co., whose general offices are in El Dorado, Kans., are two separate and distinct corporations, though their operations are closely allied. Both are nonshipper owned, privately financed, and have been promoted, designed, and engineered by C. R. C. Engineering Co., Houston.

Both the Augusta and Kaneb lines are now under construction. The segment between Augusta and El Dorado of the Kaneb system was expected to be in operation by the middle of August. Crews have been working out of both Augusta and Arkansas City. The entire Kaneb system is expected to be completed and delivery to Fairmont terminal initiated some time in November.

In the Kaneb pipe line system, there are five main-line stations, one truck-loading terminal, 43 miles of 8-in., and 203 miles of 10-in. main line. The 8-in. line originates at Wichita, Kans., and extends to Potwin via Augusta and El Dorado. From Potwin to McPherson and on to Fairmont, the pipe line is 10-in. Augusta Pipe Line consists of one main-line station at Arkansas City, and 43 miles of 8-in. main line from Arkansas City to Augusta, where connection is made with the Kaneb system. (See Fig. 1.)

Ultimately, by the installation of additional pumping units at present stations and the building of a booster station near Concordia, the capacity may be increased to approximately 50,000 bbl. per day. The steady annual increase in the consumption of petroleum products in the Nebraska trade area indicates that this ultimate capacity may be reached by 1965.

Main-Line Design and Construction

The 8-in. pipe is A.P.I. 5L, Grade B, and 5LX-42. The 10-in. pipe is all 5LX-42. To minimize line loss in the event of pipe failure, block valves will be installed at intervals of approximately 25 miles. All pipe is to be protected by a coating of coal tar enamel with an 8-lb. asbestos, glass-reinforced felt shield. To expedite cathodic protection surveys after the pipe lines have been completed, provision has been made for the installation of test leads at approximately 1-mile intervals during the line construction. Cathodic units will be installed as required after soil conditions have become stabilized. Insulating flanges will be installed at each station.

Scraper traps will be located at all stations, including the future booster site at Concordia. Hay-tank filters will be used at Augusta, El Dorado, McPherson, and Fairmont. It is planned to use an inhibitor in both pipe-line systems.

For ultimate capacity, the 10-in. line on the Kaneb system and the 8-in. line on the Augusta system will operate at a maximum working pressure of 1,200 psi. Because of the closer station

THE AUTHOR

Frank E. Hangs is chief design engineer, C. R. C. Engineering Co., Houston. He is a 1931 mechanical-engineering graduate of University of Illinois. He worked for Texas Pipe Line Co., 1933-50, Transcontinental Gas Pipe Line, 1950-52, and during World War II served as petroleum officer in China, holding the rank of lieutenant colonel. He has contributed 30 articles on technical subjects and has been part-time professor at University of Houston for 8 years.

spacing on the Kaneb 8-in. line, maximum working pressure will be 800 psi.

Stations

The only station on the Augusta pipe line will be one at Arkansas City. Since this line was expected to be in operation by September 1, a temporary motor-driven centrifugal pumping unit was installed immediately. It is anticipated that the permanent pumping units will be received and installed by November.

Since the vertical-type pumping units will be installed outdoors, the station building will not be a pump house in the usual sense of the word. The building will be rather small, with a flat builtup roof, corrugated transite walls, and aluminum sash. It will be insulated, finished with sheetrock, asphalt tile floors, and provided with central heat. As shown in Fig. 2, the station building contains an office situated to afford a good view of the pumps and station manifold, a switchgear room, a storage room which includes the fire-fighting equipment, and a small lavatory. To minimize fire hazards, no gage lines containing product will be installed in the station building. Initially, the Kaneb pipe line will have stations at Wichita, Augusta, El Dorado, Potwin, and McPherson. Potwin is an existing station with a diesel centrifugal pumping unit, but the other stations will be of new construction and similar to the one described for Arkansas City.

A temporary electric centrifugal unit was installed at Augusta making it possible to deliver products to tankage at El Dorado for further handling by another pipe line. Permanent units will be installed at a later date.

Main-Line Pumps

The main-line pumps are vertical, multistage, 3,600-r.p.m. units with explosionproof motors. To meet the initial requirements, one unit will be installed at Wichita, Augusta, and El Dorado stations. Two units, operating in series, will be required at Arkansas City and McPherson stations. An incremental increase of the system capacity may be made by the installation of additional units at each of the stations. The maximum of four units at any one station will provide for the ultimate capacity. Pump casings and flanges have been specified to permit interchanging of all units. These units, as well as all mechanical equipment except the station air compressors, will be installed outdoors.

Other Auxiliary Equipment

Other auxiliary equipment will include a 500-gal. sump tank with a rotary pump, hay-tank filters at stations which have receiving scraper traps, air-operated flow control valves with low suction and discharge controllers and station manifolds.

As will be seen from Fig. 2, the design is simple but functional, and these stations can be easily operated by one man on tour.

The station manifolds are all similar in design. Any variations are due to the number and location of the refineries' connections. Connections are being made to tanks designated by shippers. It will be necessary in nearly all cases to install booster pumps near the refineries' tanks in order to deliver the 1,000 bbl. per hour to the main-line pumps. To permit delivery to another

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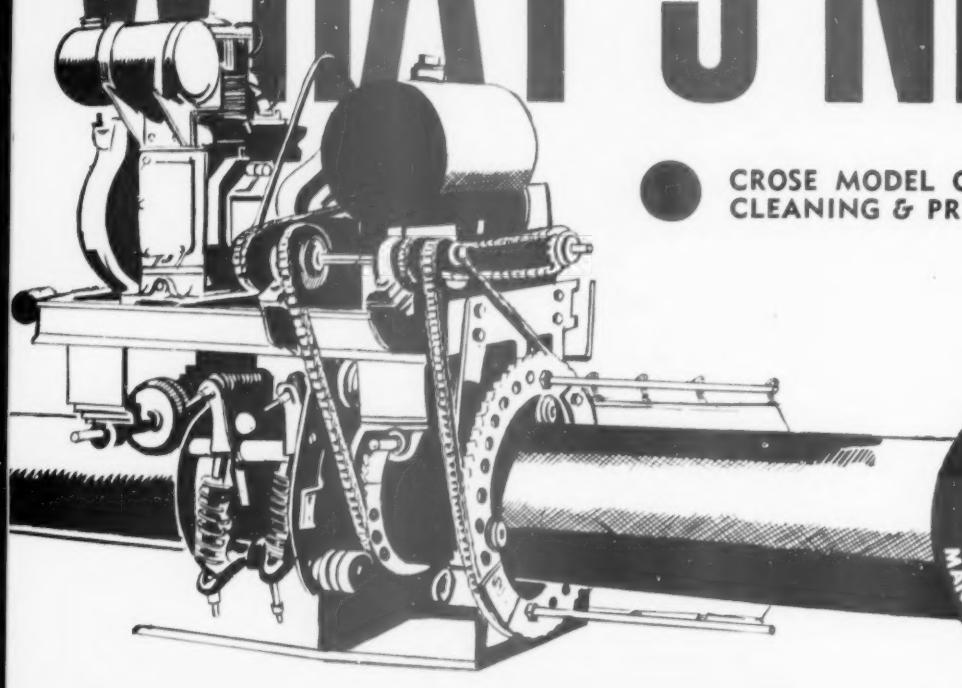

● CROSE MODEL CPF LINE-TRAVELING CLEANING & PRIMING MACHINE

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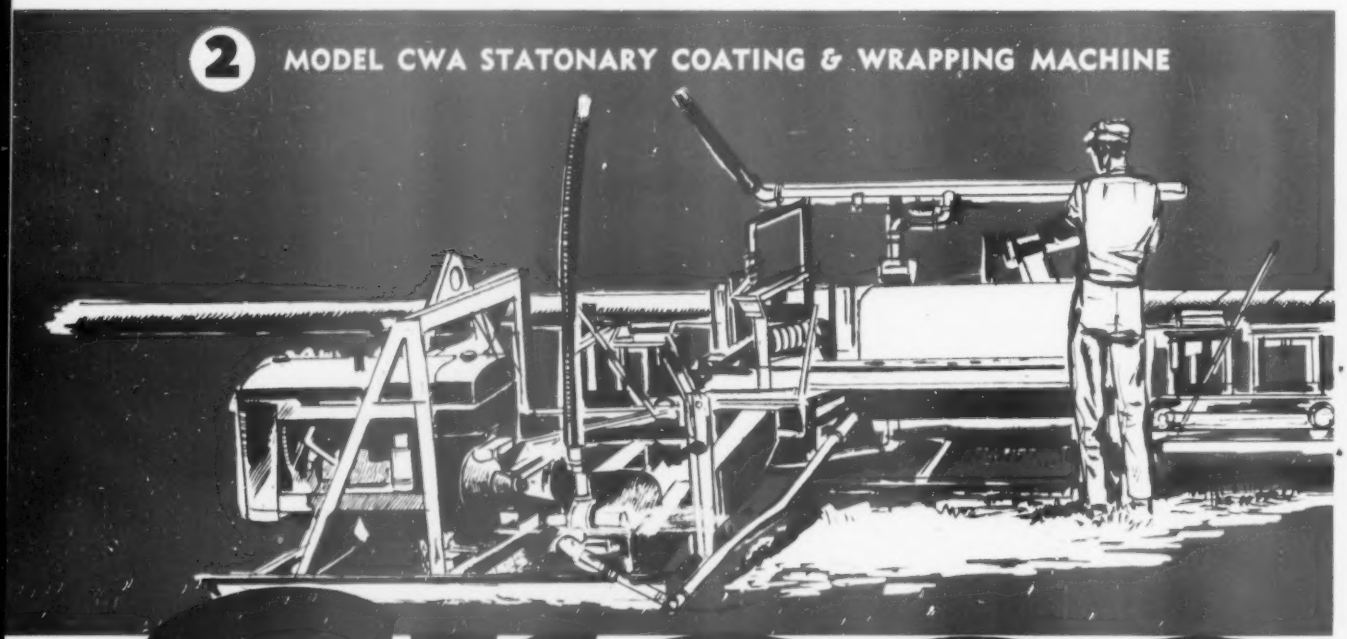

② MODEL CWA STATONARY COATING & WRAPPING MACHINE

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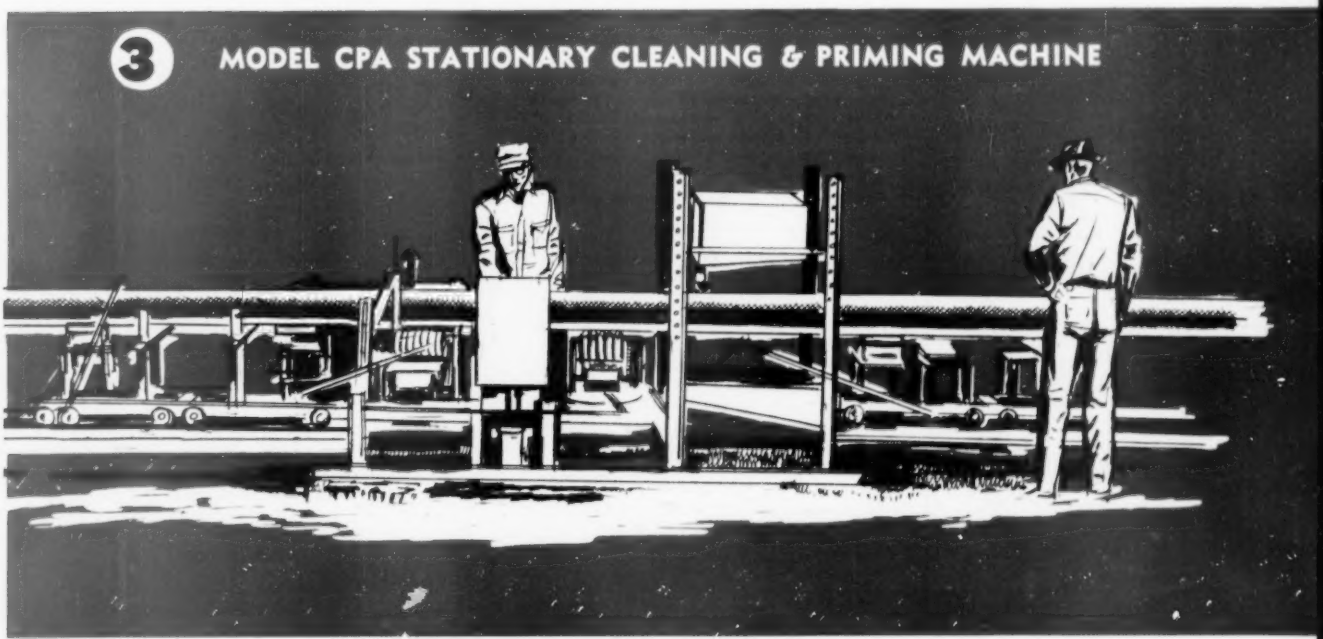
2 **MODEL CWA STATIONARY COATING & WRAPPING MACHINE**

Stationary unit for plant or yard work will coat and wrap pipe from ¾" to 10". Powered with International U-2 Gasoline Engine. Comes complete with coating pans and tanks, incoming and outgoing tracks and carriages.

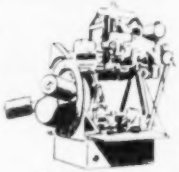
3 **MODEL CPA STATIONARY CLEANING & PRIMING MACHINE**

Stationary unit for plant or yard work will clean and prime ¾" to 10" pipe. Powered with International U-2 Gasoline Engine. Comes complete with 2 sets wire brushes, cleaning and priming tanks, and incoming and outgoing tracks and carriages.



EQUIPMENT, MATERIALS, AND SUPPLIES FOR OIL, GAS AND WATER PIPELINES

Cleaning & Priming Machines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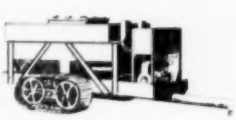
Road Boring Machines


Pipeline Kettles

Internal Line-Up Clamps

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Pipeline Cradles
Pipe Cutting & Beveling Machines
Magnesium Anodes

pipe-line system, four 30,000-bbl. tanks will be provided at El Dorado. Fairmont terminal will have the following tanks: Four 55,000-bbl., including three floating roofs; seven 30,000-bbl., two of which are floaters; and two 2,000-bbl., cone roofs. Grades and dikes for these tanks are now being prepared, and erection of the tankage has commenced. Two 100-bbl. tanks will be erected at McPherson to provide for the line fill between the refinery manifold and the pipe-line station to permit the scheduling of product movements with a minimum of lost time. All tanks will be of standard A.P.I. construction with welded joints.

Electrical

All main-line units will be operated by explosionproof motors, 440-volt, 3-phase, and 60-cycle. This voltage was chosen because of the substantial savings in switchgear for motors of 250-300-hp. range.

The power company's substation will be located near the pump station, and the switchgear is located in the station building as previously mentioned. It will be the air-break type. At Fairmont, the motor control center will be located in the tank farm.

The main-line motors at McPherson and Arkansas City will be 300 hp., while the others will be 250 hp. The air compressors will have 1½-hp. motors and the sump pumps 2-hp. except McPherson, which has a 5-hp. unit. Station auxiliaries include sump pump, air compressor, and lighting.

The principal safety devices will be low suction and high discharge shutdowns, and the usual electrical overload and high voltage protection.

Loading Rack and Facilities

Each tank at Fairmont will have a combination fill-suction line and a remote-controlled loading pump nearby. To prevent the continued operation of the loading pump under no-flow conditions, a mercury switch attached to a check valve on the discharge side of the pump actuates a time-delay device which will stop the motor if the flow is not resumed within 4 minutes. The dock and piping have been designed to load four trucks with eight products simultaneously.

Heated shelter has been provided for the operating personnel midway on the loading platform. The positive displacement meters with air eliminators and set-stop valves will be located in each delivery line beneath the rack. Ticket printers and set-stop control for the meters will be installed above the loading-floor level. Nonspark metal spouts and grounding systems are provided to reduce fire hazards. Safety handrails and nonskid floor covering will be installed on loading-platform extensions. Facilities near the loading rack will be provided for cleaning and unloading tank trucks, and the loading rack area will be enclosed by a concrete curb. This will enable any oil spilled during loading to be quickly flushed away and salvaged in an oil separator.

The office building at Fairmont will be a modern one-story brick-veneer structure, insulated and plastered inside, and centrally heated. Included will be adequate office space for operating personnel, a private office for the superintendent, a locker room, utility room, testing laboratory, and a sample storage vault, the latter two being surrounded by a fire-resistant wall. In order to expedite the billing of trucks, a convenient waiting room adjacent to the billing counter is provided for the truck drivers.

Communications

A Bell leased-wire system will be used with voice channel to Wichita, Arkansas City, Augusta, El Dorado, Potwin, and Fairmont. A private teletypewriter circuit will be installed between the El Dorado office and the terminal at Fairmont. A teletypewriter exchange (TWX) will connect offices of C. R. C. Engineering Co. in Houston with the El Dorado office.

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TYPE "S"—Contains Palconia (cellulose fiber). Performs same as Type "MF." Fiber center-tube simplifies disposal of spent cartridge by burning.
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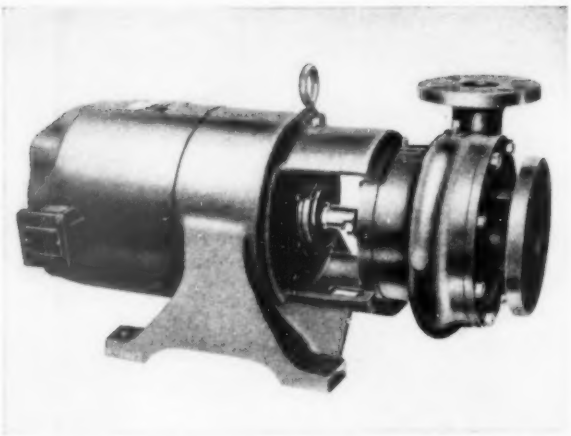
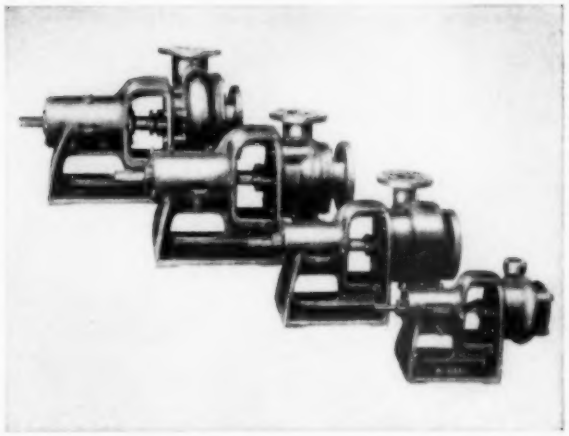
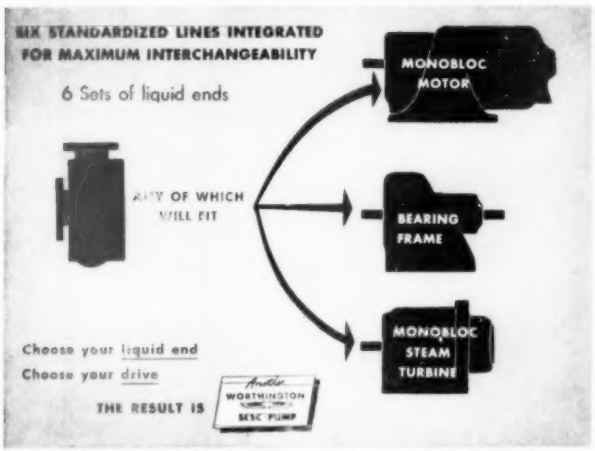


WITH BUILT-IN MOTOR—Well known throughout industry is this compact streamlined Worthington Monobloc centrifugal pump. Worthington SESC standardization makes it possible to interchange any of six sets of liquid ends to the motor housing.



FOR ANY CONVENIENT DRIVE—Frame-mounted units are available in four frame sizes. Like the Monoblocs, they use the same six sets of liquid ends and either conventional packing or a standardized mechanical seal that is readily changed in the field if necessary.

Why Worthington's SESC* pump line means greater availability, broader selection, easier servicing



STANDARDIZATION of *parts, mountings, materials* and *dimensions* virtually eliminates the necessity of slow and expensive custom manufacture to meet special pumping requirements. From 650 parts within its six standardized sets of liquid ends, Worthington can assemble 60,000 *different* standard pumps! C.3.1

Greater availability because the new Worthington pump line will handle more requirements with a *standard*, readily obtainable unit.

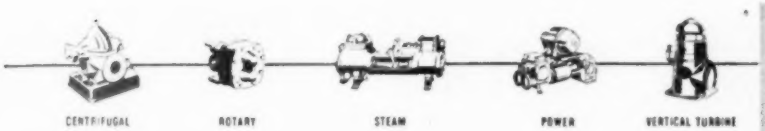
Broader selection because of the complete range of ratings and special design features in the 60,000 different SESC pumps.

Easier servicing because standardized parts mean lower parts-inventory requirements.

This sums up the advantages you can expect when you use Worthington standardized centrifugal pumps. The SESC line is Worthington's latest move towards assuring you the *right* pump for the job.

For more information, contact your local Worthington distributor or write for Bulletin W300 B-4 to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey.

**Standardized End Suction Centrifugal*



The World's Broadest Line Assures You The Right Pump For Every Job

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Centrifugal Pumps

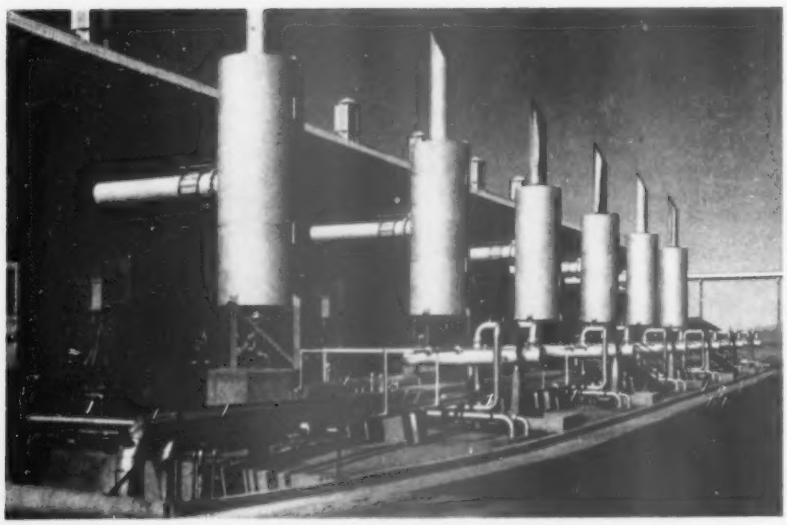
Topock compressor station before 1953 additions. Water softener and auxiliary buildings are in foreground, compressor building in background.

P. G. & E. "SUPER INCH" GAS LINE

Five Compressor Stations Deliver the Goods

Construction of compressor stations was not started at the same time as the line. Sizing and pressure rating of line were, however, based on economic considerations.

by T. L. Kopp*



Main compressor building at Topock showing exhaust mufflers. Horizontal cylinders extending out from building are heat exchangers for cooling compressor engine lube oil.

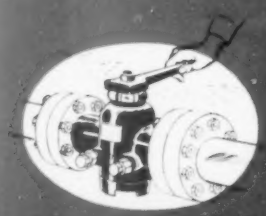
INCREASING domestic and industrial use of natural gas in California as a result of a steadily rising population and postwar industrial expansion, created such a demand on the gas reserves of the state that a new, but still economical, source of supply was required. To meet this demand Pacific Gas & Electric Co. began construction in April 1949 of the 502-mile-long gas pipe line which has now become known as the "Super Inch."

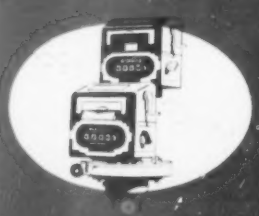
The line ties into gathering and transmission systems owned and operated by El Paso Natural Gas Co. originating in the San Juan basin in New Mexico, Colorado, and Utah and the Permian basin in New Mexico and Texas. The tiein to El Paso's line is made at the California-Arizona border at the Colorado River near Topock, Ariz., about 15 miles south of Needles, Calif. This is also the location of the

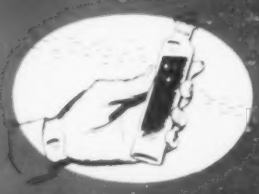
*Bechtel Corp., San Francisco.

JET-TYPE SELF-CLEANING FLUID STRAINERS

a new approach to clean pipeline products







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High-pressure rotating jets clean the strainer screen by hydraulic impact in one minute. This eliminates the dirty, time-consuming job of manually removing and cleaning conventional strainer baskets.

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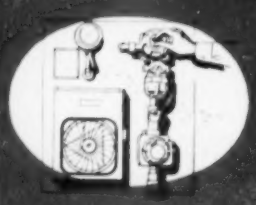
A pressure differential gauge and recorder (which tells the operator when the strainers need cleaning) and the selector and starting switches are installed on a centrally located control panel. With the use of electronic equipment, the entire strainer operation can be made fully automatic.

To get the complete story of this revolutionary fluid strainer, write for Bulletin JS-53.



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first of three compressor stations required to deliver the gas to the Milpitas distribution terminal at the south end of San Francisco Bay. The other two stations are at Hinkley near Barstow and at Kettleman Hills near Coalinga.

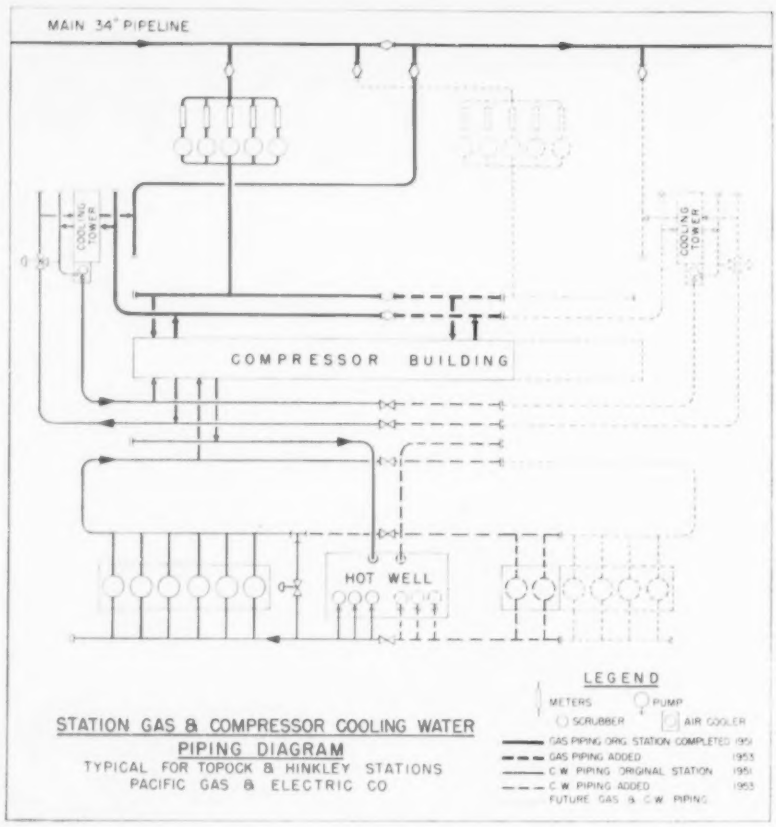
The construction of the compressor stations was not started at the same time as the line. The sizing and pressure rating of the line were, however, based on economic considerations which included the retirement and operating costs of both the pipe line and the contemplated compressor stations operating at 420 M.M.s.c.f.d. It was planned that for any increase in capacity additional compressors would be added and sections of the line paralleled as required, until ultimately the initial project would be duplicated and the capacity doubled. Since the maximum pressures in the line would be immediately downstream of each compressor station, the line was designed to have a tapered wall with five thicknesses of pipe in all to take advantage of the pressure gradient along the line between stations. To protect the weaker sections of line, pressure-limiting stations were installed at each change in wall thickness.

Compressor Stations

The line was placed in commercial operation in December 1950. From that time until completion of the stations, up to 300 M.M.s.c.f.d. of gas was received at Topock at 650 psig. and delivered straight through to Milpitas with a delivery pressure of about 300 psig. Two months after completion of the line, construction was started on the three compressor stations. The contract for design and construction of the stations was let to Bechtel Corp.

Compressor equipment . . . The work then undertaken included installation of six Cooper-Bessemer 2,500-hp. compressors at the Topock station; seven at Hinkley; and four 1,760-hp. Clark and four 1,320-hp. Ingersoll-Rand compressors at the Kettleman station. In order to provide power for lighting, utilities, and operation of the necessary auxiliary equipment to the compressors, three 340-kw. gas-engine-driven generators were originally installed at Hinkley and at Topock. Three 400-kw. units were installed at Kettleman. One additional generator has now been installed at each station. The load was originally carried by two units, and now by three, with the extra generator for standby.

Service facilities . . . Other plant facilities included a complete water supply with a treatment and storage system for drinking and utility water, fire protection, and cooling-water makeup. Oil-storage tanks and pressure-distribution systems were installed to stock and handle the two kinds of lubrication oils required (three at Kettleman) for engine operation, oil for the oil-bath gas scrubber, and for storage of used oil before disposal. One gas engine and one motor-driven air compressor were originally installed to provide utility air and starting air for turning over the main gas compressor and engine-driven generators. One motor-driven air compressor was added in 1953.



Station piping layout typical of Topock and Hinkley stations on Pacific Gas & Electric Co. "Super Inch" line.

All incoming gas to each station is metered, the main gas stream being divided into parallel flow through a bank of five 16-in. meter tubes and then through oil-bath scrubbers to remove entrained dust, oil, and foreign material before being compressed. After compression, the gas is sent through cooling coils in an induced-draft cooling tower to remove the heat of compression before return to the main line. At design conditions the gas is cooled to within 10° F. of ground temperature. The design pressure for gas piping and equipment on both the suction and discharge side of the compressors is 900 psi.

Air filter . . . In addition to the auxiliary and utility equipment required for operation of the station as a whole, additional equipment is required to operate directly with the compressors. Each compressor is equipped with a self-cleaning oil-screen air filter for cleaning the combustion and scavenging air. At Topock and Hinkley a 24-in. pipe cast in the concrete foundation of each compressor delivers 600 M.s.c.f.h. of air for this purpose. The exhaust gas is piped outside the building to a muffler and stack. Exhaust piping within the building is insulated to reduce radiation.

Cooling water . . . Some 1,600 g.p.m. of cooling water is required for engine-jacket cooling on each Cooper-Bessemer engine. The hot water is routed from the engines to a hot well from which it is pumped through multisection forced-draft fin-tube air coolers. Water flows equally through all units whether all fans are in operation or not. Control of the temperature of the water to the engines is accomplished by a conventional controller opening or closing a butterfly valve on a bypass around the coolers. When the temperature variation exceeds the limit of control by the bypass, an automatic timer turns on or off as many fan motors as required to reestablish the temperature within the limits of control of the bypass. Even

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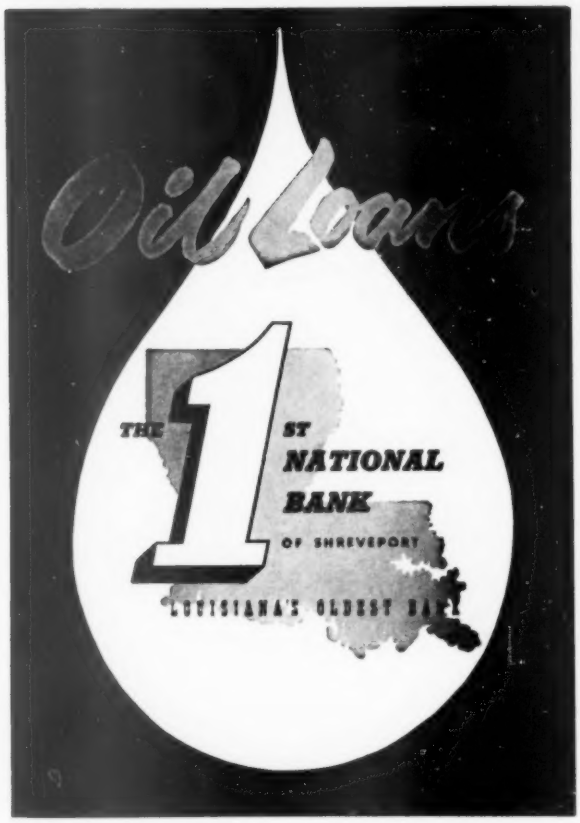

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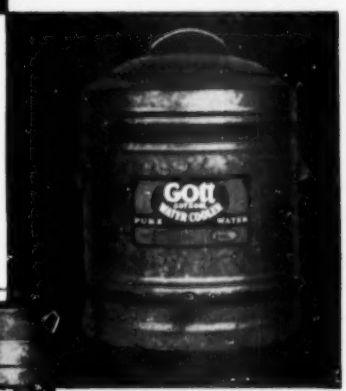

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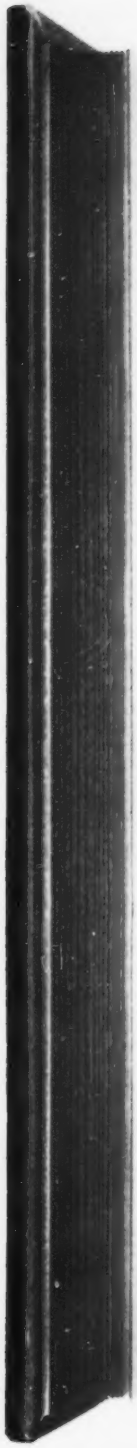

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wear of the equipment is assured by automatically alternating from one fan to another each time the timer operates.

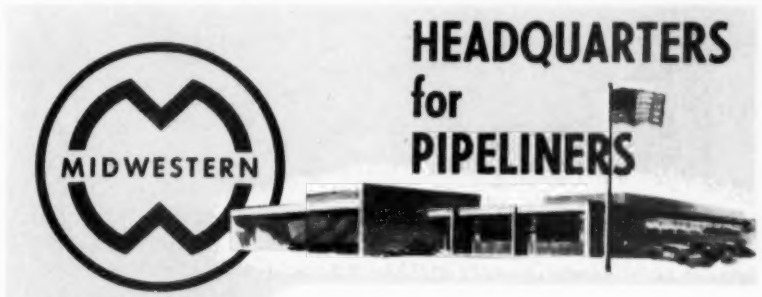
The lube oil from each engine is cooled in a shell-and-tube-type exchanger. The heat gained by the cooling water in the exchangers is rejected in coil sections installed below the gas-cooling coils in the gas-cooling tower. After cooling, this water is returned to a cold well built integrally with the cooling tower at one end. Two deep-well pumps, with a third as a spare, pump from the cold well to the lube-oil exchangers. Control of the water temperature is accomplished by a three-way valve arrangement in the water line to the cooling coils with a bypass, which returns water directly to the cold well as required.

Separate systems are provided for makeup oil to the compressor and generator engines. For temporary disposal of oil other than to the used or dirty-oil drain return system, the oil from the compressor engine crank cases can be drained to a nearby buried drain tank for storage during inspection or minor repairs to the engine. Compressed air then is used to blow the oil back to the engine. A similar installation was made for the generator engines at Topock and Hinkley in connection with the 1953 station additions.

Generators . . . Operation of the generator engines requires essentially the same auxiliary equipment as the compressor engines. The auxiliary systems for the generators are kept entirely independent of the compressor engine operations. Cooling is effected for both the jacket and lube-oil cooling-water systems by use of forced-draft fin-tube air coolers similar to those used for the compressor jacket water. Surging and thermal expansion of the cooling water are taken care of by vertical surge chambers fabricated from large-diameter pipe; no pump basins were required. Engine-jacket cooling-water control is identical to that of the main engine-jacket water coolers. Lube-oil cooling water passes through separate coils in the same air coolers and is controlled by a three-way valve arrangement bypassing the coolers.

At the Topock station the meter house for the inlet gas meters is air-conditioned to maintain a constant temperature, thus insuring maximum accuracy of the instruments which record the flow of gas into this, the first station on the line. At Hinkley station the gas meters are locally mounted adjacent to the scrubbers. At Kettleman the inlet meters record locally and also transmit to a central control house where operations are coordinated between the new station for the Super-Inch gas line and P.G.&E.'s older Kettleman Hills compressor station. At this central control point, gas meters are installed for three major pipe lines entering and leaving the combined station. Rates of flow for the principal pipe lines supplying gas for northern California are controlled from this location. During the night hours when the gas demand is lowest at the terminus of the line, the Kettleman station continues to operate at substantially its full rate, as governed by the anticipated demand for the next day, in order to pack the line to the north to the maximum allowable working pressure. This permits the withdrawal at Milpitas during peak demand hours of considerably more gas than the average design rate. In effect, the line from Kettleman to Milpitas provides about 70 M.M.s.c.f. of storage capacity.

Controls . . . The main controlling, recording, and alarm instruments for the gas system within the station and for compressor operation are located on a panel in an open bay of the compressor building. At Topock and Hinkley the operating bay was originally located at one end of the initial bank of compressors so as to be centrally located when all future compressors are installed. At Kettleman the control bay



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was centrally located between the Clark and Ingersoll-Rand compressors.

Station shutdown . . . In addition to provision on each compressor for automatic shutoff of its individual fuel gas supply when actuated by high jacket-water temperature or low lube-oil pressure, a station shutdown system was installed whereby in emergency the entire plant may be shut down and the gas within the station vented to atmosphere by actuation of any one of several "shutdown" valves located at strategic points in the plant. Air-actuated piston operators are installed on the main-line inlet and outlet valves and on a blow-down valve located in the station discharge gas piping. Air pressure is supplied on one side of the cylinder operators by a shutdown air-storage tank constantly maintained under pressure and sized to contain sufficient air reserve to operate all valves in the system, even though the plant air system should fail. The other side of the cylinder operators is also normally under balanced pressure from the "shutdown loop." An "air to open" diaphragm control valve in the fuel-gas system is also kept open by this pressure. In an emergency any one of the several vent valves on the shutdown loop may be opened, thus unbalancing the pressures on the cylinder operators and causing them to function.

Compressor Buildings

The compressors at each station are housed in rigid-steel-frame, transite-covered buildings. To reduce the hazard of a fire or explosion, piping and auxiliary equipment to the compressors are laid out so as to keep high-pressure gas on one side of the building while the air intake, mufflers, cooling water, fuel gas, etc., are on the other. A smaller, but similar, building was installed at each station for the generators, utility equipment, machine shop, operators' office, and laboratory. Additional buildings were installed at each station as required to meet their individual requirements. Extensive facilities, including offices, were installed on property adjacent to Hinkley station for storage and repair of maintenance equipment servicing the southern pipeline division.

The preceding descriptions of equipment and methods of operation primarily refer to Topock and Hinkley stations, but also apply in general to Kettleman. While Topock and Hinkley were originally designed and laid out with provisions for future symmetrical duplication of the station in parallel, Kettleman was designed initially on a symmetrical pattern with four Clark compressors on one side and four Ingersoll-Rand compressors on the other. Due to the difference in design and rating of the compressors at Kettleman, it was necessary to provide nearly all independent auxiliary systems for their operation. Equipment and line sizes were selected, where practical, to provide for an ultimate expansion of four additional compressors of each type. In other respects designs for each of the systems are similar to those for Topock and Hinkley.

Late in 1952 Bechtel Corp. started engineering and construction for the installation of additional compressors at each station. Two Cooper-Bessemer compressors were added at Topock and three at Hinkley, while four Clark compressors were added at Kettleman. Included in this expansion was the addition of one generator and one scrubber at each station along with the necessary pumps, coolers, etc., for the operation of the new compressors. Cooling-tower additions will not be made until the stations are further expanded.

These additions were completed in July at the Hinkley and Kettleman stations. Construction at Topock was completed in August. With these additional compressors and with approximately 90 miles of pipe-line loops which were also added this year, the line capacity has been raised to 550 M.M.s.c.f.d.

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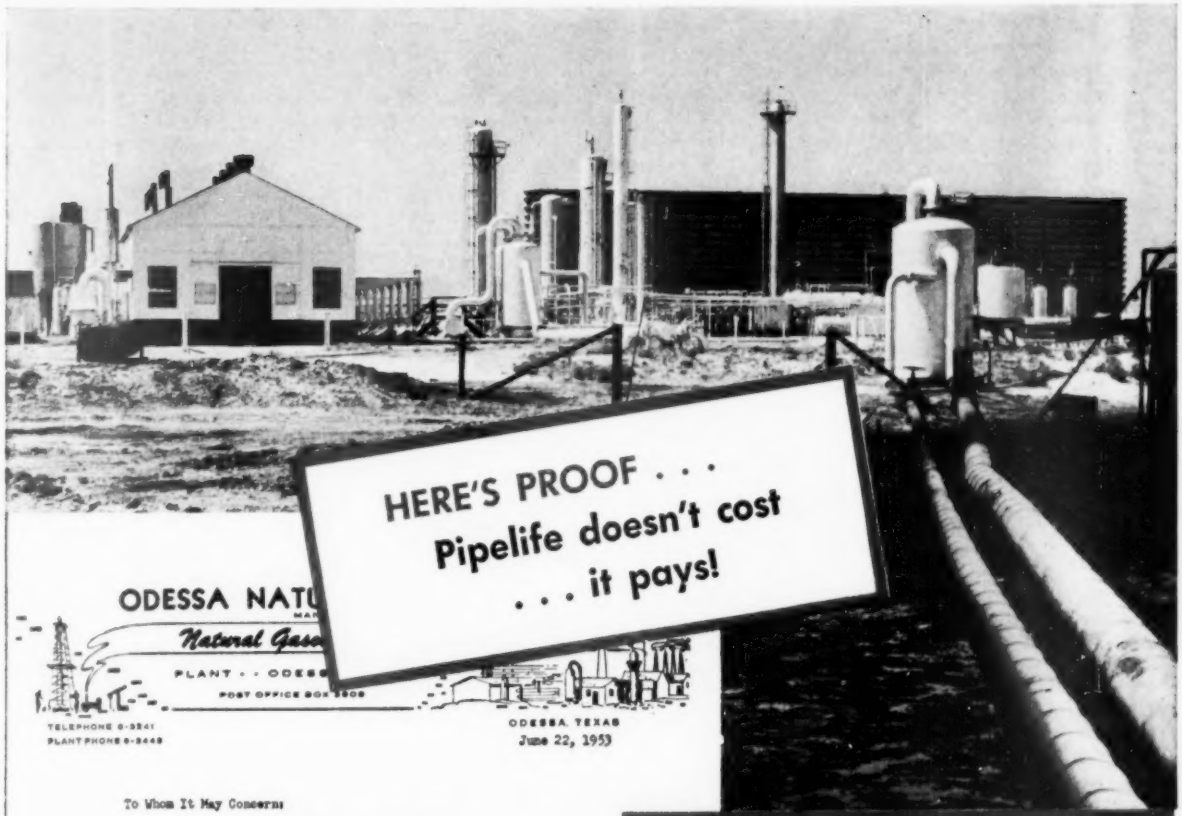

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WE RELEASE THE FOLLOWING REPORT:

In the latter part of 1948, our company planned to expand our facilities to pick up flared gas in the South Cowden Field near Odessa, Texas. Because of a steel pipe shortage at that time, new pipe could not be obtained and the company purchased approximately 126,000 feet of light-weight 3rd class invasion pipe, sizes 4", 6", 8", 10" and 12" that had been used in water systems. Tubercular formations had substantially reduced the inside diameter of all the pipe. After cleaning and close inspection, it was found to be in critical condition. It was badly pitted and full of small pinholes. An attempt was made to make repairs by welding, but the pipe was in such poor condition that the repair program was abandoned.

At that time, a new company with a new process of cleaning and plastic-coating pipelines (in place) was proving their method of internal pipeline protection in the field. After investigation of this new company, known as Curtis-Tomlinson Co., Ltd., now PIPELIFE, INC., of Odessa, Texas, Odessa Natural Gasoline Company entered into a contract with Curtis-Tomlinson Co., Ltd., to lay, clean, and plastic-coat internally (in place) the entire gathering system. After the plastic coating job was complete, the lines were tested with 120 p.s.i. air pressure and no leaks were found.

These lines have been in constant service since 1949, and no failures have occurred. All lines have given over four years of satisfactory, trouble-free service. Uncoated (new) pipe carrying the sour gas from this same field will begin to fail from internal corrosion in three years or less.

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PIPE-LINE RIGHT-OF-WAY through wooded country is pretty well defined but it takes a well-trained pilot to follow route across flat country. Close observation of gathering lines from individual wells is difficult but highly important. Trees above are obstructing the pilot's view of pipe-line route.

INDICATION OF LEAK is only one of 20 conditions specified in contracts for pilot to watch. Case histories show tractors have plowed through pipe lines and once a portable rig moved in overnight and drilled into a carrier pipe. Rapid expansion of city utilities makes heavy construction machinery like above a daily menace to pipe lines.

BRIEFING THE PILOT . . . J. D. Phillips, left, chief pilot for Gleason Romans Aviation, Inc., Pipeline Patrol, Tulsa, and Culver Nesmith, Tulsa area pilot, checking pipe-line route map before making flight. Sixteen pilots and 12 planes patrol for 8 companies. Plane, above, is a four-place Cessna 170, headquartered in Tulsa for emergency or distant flights, while the type used in regular patrols are two-place Cessna 140's, Pipers and Luscombs. A northern plane is ski-equipped and one on Gulf Coast is a float plane.

Airborne Trouble Shooters

by Carl Hoot
District Editor

THE business of patrolling pipe lines carrying oil or gas has come of age and with its maturity have come many changes in operating methods.

Some early patrolling of natural-gas pipe lines was done at the beginning of the 1930's, but the first large-scale patrolling of pipe lines was initiated by Shell Pipe Line Corp. in 1939, shortly after Gen. Jimmie Doolittle became aviation head of the Shell interests.

Currently, air patrolling of pipe lines is extensively done by both pipe line companies and patrol contractors. Operations of a patrol contractor are exemplified by Gleason Romans, Inc., Pipe Line Patrol, Tulsa. Information for this article was obtained from this firm while studying its methods. Photographs were taken to illustrate this article while flying with Romans' pilots on regular patrols and two emergency flights over a period of several weeks.

Contract patrolling . . . The first extensive contracting of pipe-line patrolling was undertaken in 1946 when Gleason Romans recognized the economies to be achieved by systematic elimination of deadheading as the result of a network of contracts. Today his company contracts with 8 pipe-line firms and his 12 planes patrol from the Gulf of Mexico to Lima, Ohio, on regularly scheduled flights.

District patrol bases are maintained at Lima, Tulsa, Sulphur Springs, Ranger, Midland, and Houston, Tex.; La Fayette, La., and Laurel, Miss. In addition to providing for the regularity of scheduled patrols, the firm has planes and pilots available for emergency call.

Companies having extensive aviation facilities for the transportation of personnel may also patrol their own lines in small company-owned planes, tying their duties in with their pipe-line operating department.

Where patrolling is done on a contract basis the pipe-line operator pays only for mileage flown over his lines. This is feasible where two or more pipe-line companies have intersecting or parallel routes which facilitate working on the round trip.

Cost of airplane patrol contracted by a pipe-line owner runs approximately 20 cents per mile. This charge is based

MARKERS for pipe-line right-of-way are placed on fences, posts, or utilities poles as shown here. To train a pilot to be a competent observer requires approximately 6 months. The route must be followed automatically with all attention on conditions along the line. Notes are made while flying on such items as erosion, conditions of rivers, streams, etc.

AN OIL LEAK is indicated by dark stain through center of this picture. Leak was of major proportions, resulting in an emergency patrol being authorized. Cleanup crew has already moved in with suction equipment and tank, upper right, and has cleaned oil off the ground.

Safeguard the Nation's Pipe Lines

on pipe-line mileage, without deadhead charges. Deadheading is where the plane flies a one-way patrol, then doubles back over the same route to reach its home station, which necessitates a two-way price.

In serving a network of pipe lines from the gulf to Lima, flights are so arranged that deadheading is practically eliminated. Short flights from one company's lines to another are borne by the patrol company.

Route . . . A network example is one of the Houston area pilots' runs which starts in the Sour Lake area for Gulf Refining Co., then proceeds north along the right-of-way to the Perryman pump station near Tulsa. Reports on conditions along the line are filed at the patrol company's headquarters at Fifteenth Street Airpark, Tulsa.

The following day the same pilot makes his return trip via The Texas Co.'s line, picking it up at the Cushing pump station southwest of Tulsa and proceeding to Wichita Falls, Corsicana, and Houston.

This practice can also be applied to pipe lines of lesser length. Flying pipe-

PUMP STATIONS like this usually mark the end of a patrol plane's flight. When leaks are suspected, or conditions warrant immediate checking by maintenance crews, pilots drop a weighted and streamered message to nearest station along the line. Where pipe-line companies are radio equipped, immediate contact is made between patrol plane and pipe line.

Department of the Army

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Provides facilities for the complete gasification of approximately 20 tons of coal per day to produce a carbon monoxide-hydrogen mixture which is used in the synthesis of hydrocarbon by the Fischer-Tropsch process. Capacity: 40 to 80 barrels of liquid fuels a day and, in addition, by-products.

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CORPS OF ENGINEERS U. S. ARMY WASHINGTON, D. C.

line inspection west from Ranger in North Texas begins on Gulf's line. The route leads to Wink in northwest Winkler County, and the return trip is via Texas-New Mexico Pipe Line Co.'s carrier starting at Jal, N. M., running southeast to Houston. From Houston the plane is routed back on Gulf's line near Lufkin, patrolling that line to home base at Ranger.

Staggering runs . . . Where a company is equipped to have two or more planes operating from the same base, patrol runs are staggered to keep one pilot and plane always on call for emergency flights. Emergency patrols are authorized by pipe-line-company dispatchers when they detect tank shortages or pressure-drops along the line and a line leak is suspected. A phone call any time of day or night is made to the district pilot who covers the pipe line in question, or to the patrol company's main offices. Contract patrol companies should have additional planes available which can reach any pipe line under contract within an hour.

There are times when apparent shortages are due to conditions other than line leakage. Temperature changes can reduce oil storage to the point where a shortage is suspected, and in one case on record the dispatcher called for repeated emergency patrols over his line for a period of several days. Pilots were unable to detect visible shows of pipe failure along the line and after ground crews had walked the entire distance all pipe-line valves were closed for testing. It was then found that a leaking valve, tied into unused storage, had nearly filled a 55,000-bbl. tank with the "lost" oil.

On the contract basis dealt with here the air patrol cost per mile is approximately 12 per cent of the fixed cost of the old pipe-line walker. The walking inspector has not been entirely eliminated. He serves in a more efficient capacity for inaccessible or close-in areas.

For the uninitiated pipe liner, reputable patrol companies are more than willing to provide a substantial, well-cared-for airplane and competent pilot for a trial observation flight. From a position above the pipe-line right-of-way and at relatively slow speed, it is easy to convince the skeptical why these airborne trouble shooters have earned their place in the pipe-line industry.

New Viscosity Standard

Beginning on July 1, 1953, National Bureau of Standards adopted the value of 0.01002 poise for the absolute viscosity of water at 20° C. as the primary standard for the calibration of standard viscosity samples and viscometers.

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1 Photo showing Peerless Line Separators at Pipeline Station in Oklahoma.

2 Peerless Horizontal Separator handling 240,000,000 cu. ft. per day, while removing condensed liquid from cooling tower, at plant in California.

3 Two Peerless Vertical Scrubbers at a power plant in South Texas, each handling 50,000,000 cu. ft. of gas per day.

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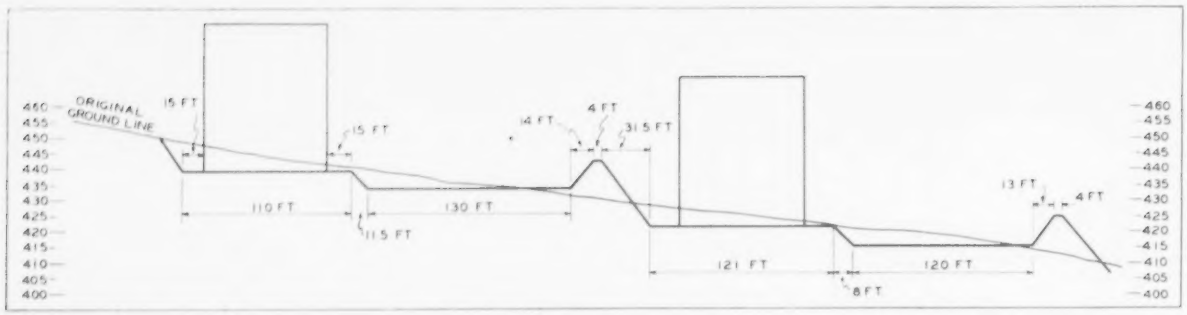


Fig. 1—Typical section of tank farm, showing elevations for stepped-down construction.

Fig. 2—Side-hill tank grades with stepped-down diked areas.

Fig. 3—Tank bases showing stepped-down locations.

Step-Down Plan Saves Grading Costs

Take advantage of natural slope and drainage to achieve balance between fill and excavation

by F. J. Norton*

DRAINAGE, soil stability, bearing capacity, many other problems in soil mechanics, as well as economics of balancing fill and excavation may be involved when a grading project is under way. These factors had to be considered when it became necessary for Eastern Pipe Lines Division of Socony-Vacuum Oil Co., Inc. to erect one 54,000-bbl. tank and three 42,500-bbl. tanks at Malvern, Pa. Junction, in connection with the construction of an additional pumping station on the Pennsylvania-New York system.

The only available area large enough at the junction was a side hill on a 9 per cent grade sloping diagonally through the tank site. There was nothing unusual in the construction of the tanks, piping, etc., as they were of more or less standard design. The main problem was the hillside grading. Accessibility for maintenance trucks, etc., made it necessary to have a minimum level area 15 ft. wide around each tank.

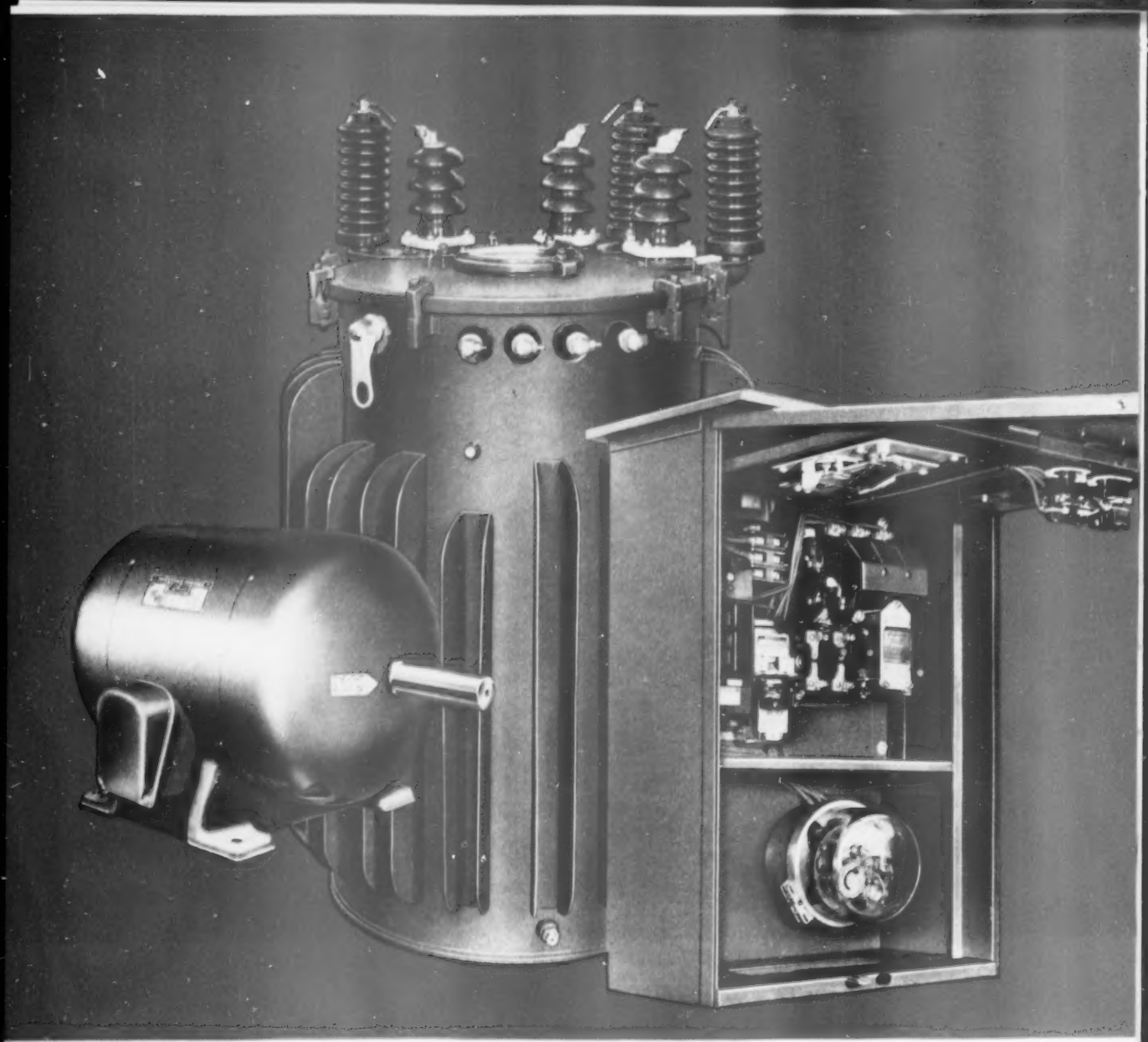
Two-level plan . . . The original plan

*Senior mechanical and building engineer, Eastern Pipe Lines Division, Socony-Vacuum Oil Co., Inc., Plainfield, N. J.

Westinghouse equipment pumps up lease electrification savings

A convincing number of operators are proving, day after day, that electrified pumping pays off in substantial savings. At Smackover field, for instance, electrified pumping reduced lifting costs 36%. At McCamey field, according to many operators, it saved enough to offset power costs. And at a 49-well lease in the Healdton field, pumping costs are only 4.1¢ per barrel, with the installed cost of the power line, including transformers, totalling only $378 per well.

Sound reasons underlying the use of electricity are outlined on the following pages. Also, you'll see the electrical equipment—Westinghouse equipment—that pumped up these savings.



Westinghouse three-unit team puts profit in electrified pumping

Weatherproof, dead-front control units are specially designed for the control of oil well pumping motors. Enclosures are NEMA III weatherproof type to permit outdoor pole-mounting close to the pumping motor. The control provides for across-the-line motor starting with complete overload and low voltage protection. It is available in two general types: the Automatic Unit, which automatically controls pumping by means of a built-in time switch, and the Local Control Unit, which provides for manual control only. Controllers are available with AB Circuit Breaker or Fusible Disconnect.

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How electrified pumping pays off . . .

Fewer men, fewer trips . . . Electrified pumping with automatic controls eliminates daily inspection trips to the well. Often, one man can handle several leases located miles apart. Westinghouse control equipment, for example, starts and stops pumping on a repetitive daily or weekly cycle. Set the time switch and leave it alone!

Scientific pumping . . . Electrification permits the automatic control of the pumping periods—an economical procedure when wells are at low fluid levels. Nothing is left to the operator's whims. Each well can be pumped precisely as it should be for maximum production.

Less wear and tear . . . Continuous, smooth and steady power delivery by electric motors produce little wear, shock or overload on your equipment. Automatic starting and stopping halt excessive fluid pounding and damage to polished-rod packings if wells suddenly go dry.

No maintenance problems . . . You can run a Westinghouse Life-Line Motor many years before maintenance is necessary, but you must overhaul a multicylinder gas engine every 2 to 4 years. Life-Line Motors need no lubrication. Gas engines require a daily checkup, frequent lubrication and addition of water and antifreeze to the cooling system. These are examples of how electrified pumping reduces your lease maintenance problems.

Winter-proof . . . A Life-Line Motor starts easily on cold mornings. No cooling system to freeze. Lightweight and compact, it can be installed or moved easily. Lastly, electrified pumping brings power to your lease for other purposes.

Westinghouse can help you capitalize on the profit possibilities in electrified pumping. On these pages, you'll find evidence to back up this statement.

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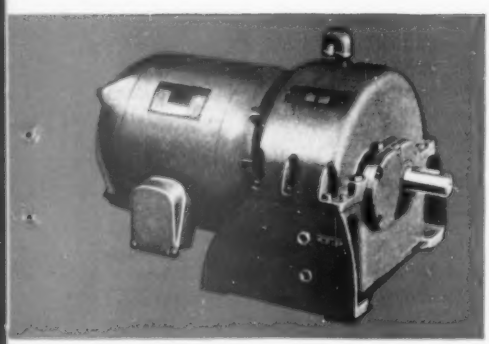
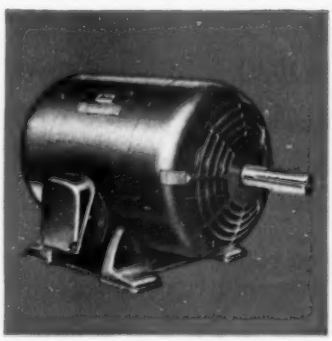
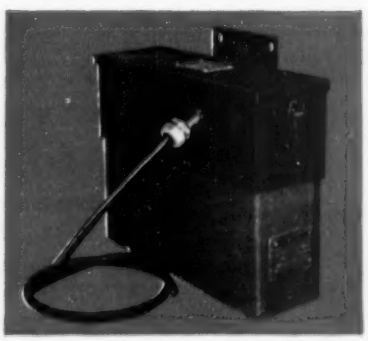


Long service life, with little maintenance, keynotes Life-Line Gearmotors. Heat-treated gear teeth absorb shocks of heavy-duty service. Split-case construction permits easy access to working parts for inspection or servicing. Antifriction bearings maintain accurate gear centers and reduce wear. Integral motor design makes entire unit compact.



Life-Line TEFC (totally-enclosed, fan-cooled) motor meets the needs of pumping installations located where the weather is unusually bad. Dust, sand, heat, insects and rodents can't impair the motor's operation. Tuffernell® insulation and Tufvar® synthetic resin-covered wire are used. Complete stator is dipped and baked in thermal setting varnish.



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was to excavate the hillside in two levels, each surrounded by a common dike. This plan called for an excavation of approximately 45,000 cu. yd. of earth with a good chance of encountering solid rock on the high side, and was abandoned in favor of a two-level plan for each tank site, which required 25,000 cu. yd.

The layout plan for the tanks in relation to each other and in relation to property lines, existing buildings, etc., is regulated by Pennsylvania state codes covering the storage of inflammable liquids. The state code also requires that the volume contained within the dikes be equal to that of the tanks, which establishes the dike elevations.

Advantage of the natural slope of the ground was taken in stepping down the various levels. A balance was established between fill and excavation as nearly as practicable. (See Fig. 1.)

Dike Construction

The elevation of the tank base was controlled by the requirements for sufficient area for operation and maintenance. The elevation of the stepped-down area was controlled by the amount of earth available from the tank base cut to establish a level area and to construct dikes to the required height. Dikes were constructed 2 ft. above the required elevation to allow for shrinkage. The tops of all dikes on the high side of the grade were a minimum of 2 ft. above the elevation of the base of the tank, thus making the volume of the lower level equal to the volume of the tank. (See photo, Fig. 2.) In case of spillage all products would flow to the lower level, leaving the tank base level free of products, which would expedite any repairs to the tank or piping that might have caused the spillage.

Easy approaches . . . This method of grading has the decided advantage of enabling vehicles to enter the areas enclosed by the dikes by constructing ramps at grade points in the various areas. (Fig. 3.) This makes the lower levels within each tank area available for storage of pipe and other material.

Drainage . . . Storm-water drainage is provided by constructing catch basins in one corner of the low area with a 6-in. pipe drain through the dike. The amount of water allowed to accumulate in the lower level is controlled by a 6-in. valve on the outlet end of this pipe. The valves are kept closed at all times except when draining accumulated water. An intercepting open ditch has been constructed across the high side of the property outside of the diked tank area to prevent storm water from entering the tank area from the hillside above.

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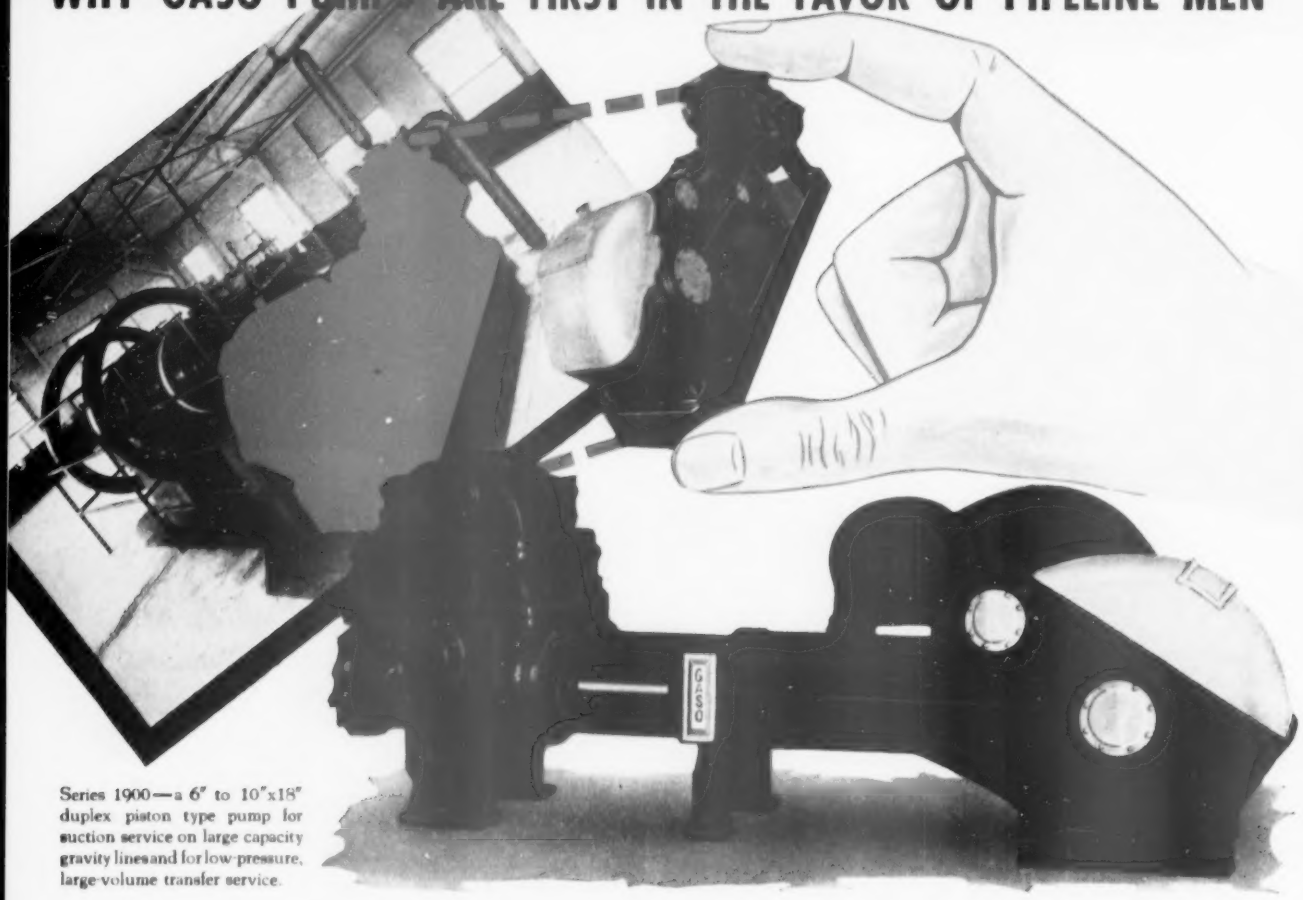

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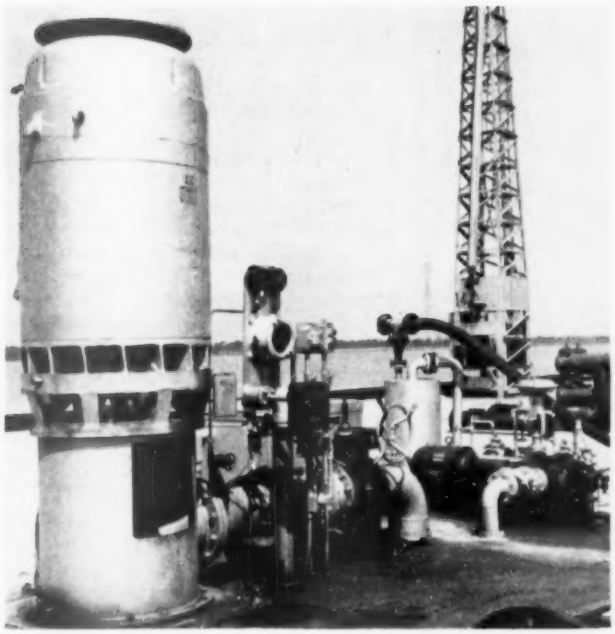
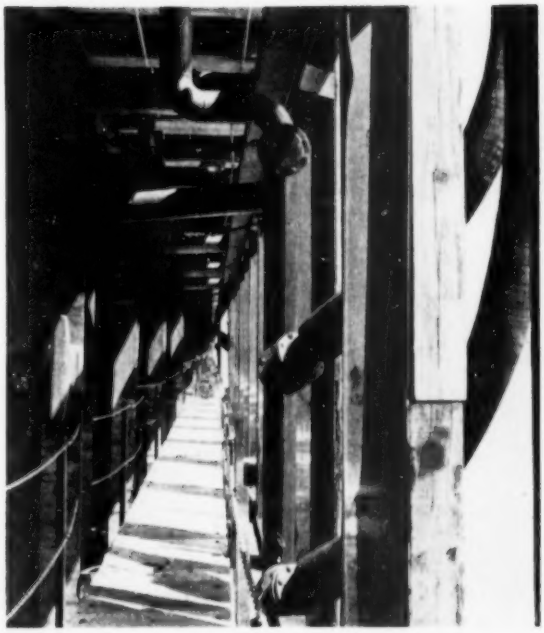
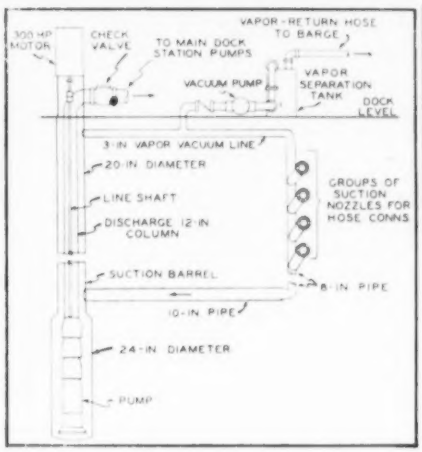
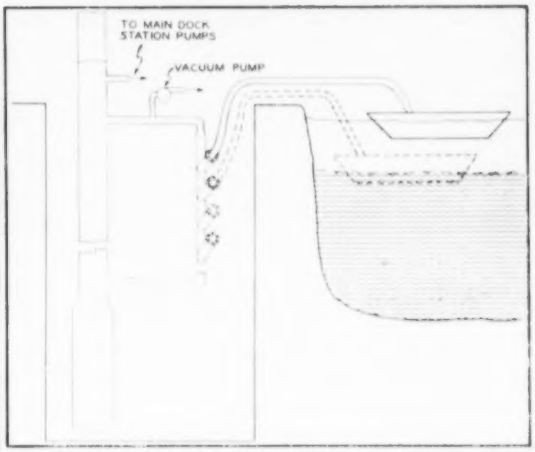








These photos and sketches show how Plantation's barge-unloading system works. A 300-hp. electric motor is used to drive the vertical centrifugal pump located below river level. In photo at left can be seen 8-in.-diameter riser underneath dock. This is equipped with flanged nozzles set at varying heights so that barge hoses can be easily connected as the river level changes.

Plantation Pipe Line Provides

HIGH-CAPACITY BARGE UNLOADING

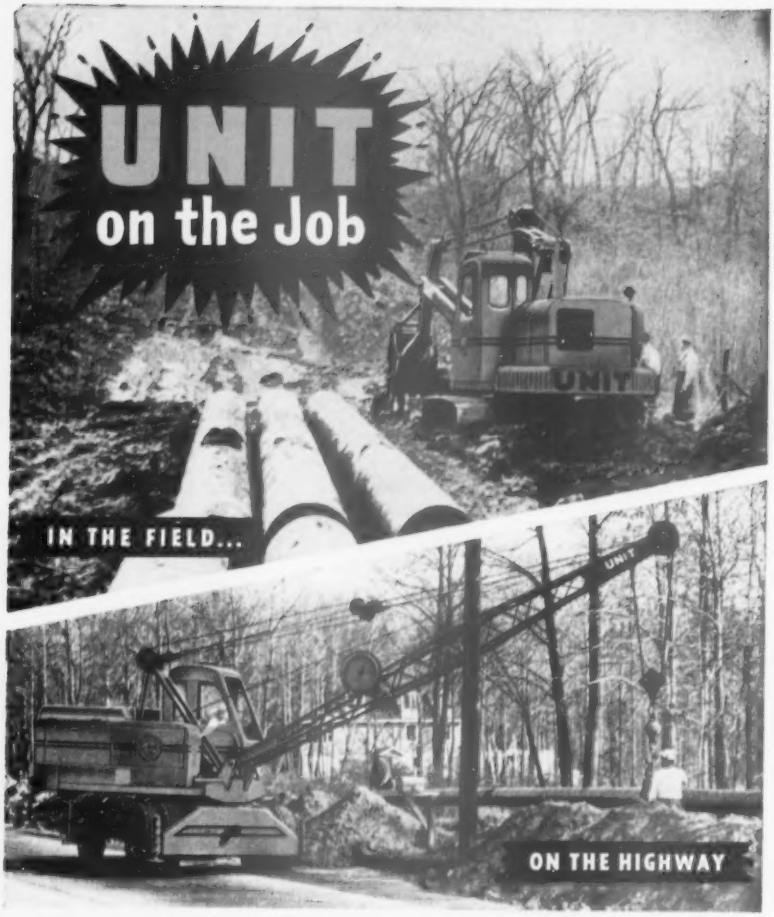
at Baton Rouge Terminus

by F. Lawrence Resen
Gulf Coast District Editor

A VERTICAL barge-unloading-type pump used in combination with a vacuum pump is providing high-capacity unloading facilities at Plantation Pipe Line Co.'s Baton Rouge docks.

The installation utilizes the vacuum pump to vent air and vapor back to the barge through a vapor separation tank, thus creating a partial vacuum. This enables oil from the cargo compartments to siphon through the barge unloading hoses to the suction side of the vertical pump. Flanged suction nozzles are located at various levels in a riser section of the suction line. As the level of the Mississippi River rises or falls the barge-unloading hoses can be connected at that group of nozzles corresponding in level as nearly as possible to the river water level. (Fig. 1.)

These unloading facilities (two complete installations have been made) figure quite prominently in Plantation's system, for in addition to products obtained from Esso Standard Oil Co.'s refinery at Baton Rouge and the Bayou Pipe Line System, all other products



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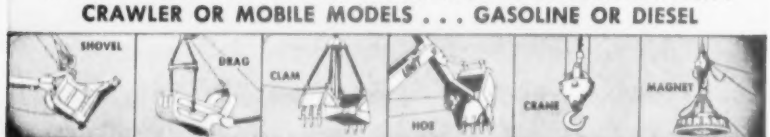

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which enter the line at this western terminus come via water transportation.

Layout . . . The two barge-unloading pumps were provided for Plantation's 750-ft. extension to Esso's oil unloading and loading dock and are located along its center. The pumps are both vertical, centrifugal, motor-driven, deep-well installations which extend downward from the top of the dock so that the bottom of each sump is, in these particular installations, some 15 ft. below the surface of the river at its lowest stage.

Advantages . . . Advantages of this installation include:

1. It is unaffected by rise and fall of the Mississippi. The pump, permanently installed below the surface of the river which can rise or fall up to 45 ft., is always pumping against the same static head, regardless of river conditions.

2. Elimination of high suction lifts. Since fluid is fed to the pump suction barrel by gravity, there is no initial suction lift to be overcome. With the changing level of the river, the suction lift could vary greatly so that a pump permanently located at the dock level would be useless at low water levels, while a portable pump would have low capacity.

3. High capacity. With a permanently installed unit high capacity may be realized. While a pump installed on a barge could unload the cargo compartments, it would not have the high capacity available with this installation.

4. Simplicity of design. The design is relatively simple, with the majority of equipment located on the dock for ease of maintenance.

Design . . . The pump is driven by a 300-hp. electric motor located on the dock, with the shaft extending downwards through a 12-in.-diameter discharge column from which the pump is suspended. This column is 50 ft. in length, in the Plantation installation, and connects to a check valve and discharge gate valve through which fluid passes on its way to the main dock station pumps, then through 6 miles of line to a manifold and on to the tank farm.

Surrounding the 12-in.-diameter discharge column and the pump is a large-diameter casing which extends 60 ft. below the dock level and is capped at its lower end. This casing consists of 20-in.-diameter for a 50-ft. length, while its lower 10 ft. consists of 24-in. diameter.

Fluid enters the suction barrel through a horizontal 10-in. pipe which is welded to the casing 15½ ft. above its lower extremity. The horizontal line,

in turn, connects to an 8-in. riser equipped with nozzles for connecting to hose lines. These nozzles are located at various levels so that hoses may be connected close to the water level no matter how the river rises or falls. The nozzles rise at an angle of 45° to permit hoses to be conveniently attached.

The top of the riser is connected to a 3-in. vapor-vacuum line which runs horizontally just under the dock and connects to the suction barrel casing. A 3-in. riser runs from about the center of this horizontal line through the dock floor to a vacuum pump, with the following design specifications: 205 cu. ft. of air at 1,160 r.p.m. and pressure of 10 in. Hg.

How it works . . . In operating the installation, a hose(s) from a barge is connected to a suction nozzle(s) nearest the water level and the vacuum pump is started. Air and vapors are exhausted from the suction line and casing so as to create a vacuum which is controlled by a vacuum-actuated mercoid switch. This vacuum controller is adjusted to maintain the maximum permissible vacuum for the fluid being pumped and at the flow temperature. Once a vacuum has been established, oil siphons through the barge pipe line, and hose connections, utilizing atmospheric pressure as a driving medium.

Vapors evacuated from the casing and suction lines are vented back to the cargo compartment after entering a separation chamber downstream of the vacuum pump. A level controller is provided in the vacuum control circuit to avoid excessive rise of oil level within the casing. This is necessary inasmuch as during high river stages oil would be lifted, on the basis of the maximum permissible vacuum, to a level above the inlet of the vacuum pump. The level controller acts as a safety device prohibiting excessive rise in level. During pump operation, however, pressure drop in the system normally permits the evacuating system to operate on vacuum control.

Pump . . . Oil is pumped from the suction barrel by a four-stage, centrifugal Byron Jackson unit, driven by a 300-hp. explosionproof vertical motor located on the dock. The pump is rated at 2,300 g.p.m. or 3,286 bbl. per hour at 1,750 r.p.m., 401 ft. total dynamic head.

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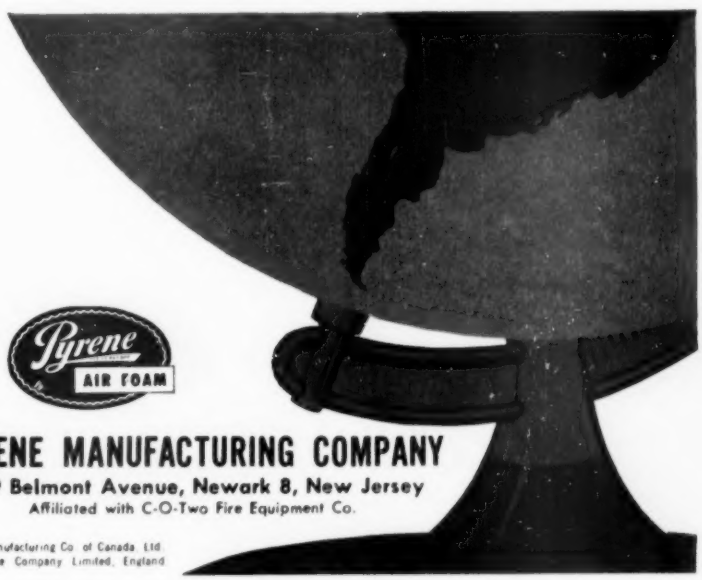

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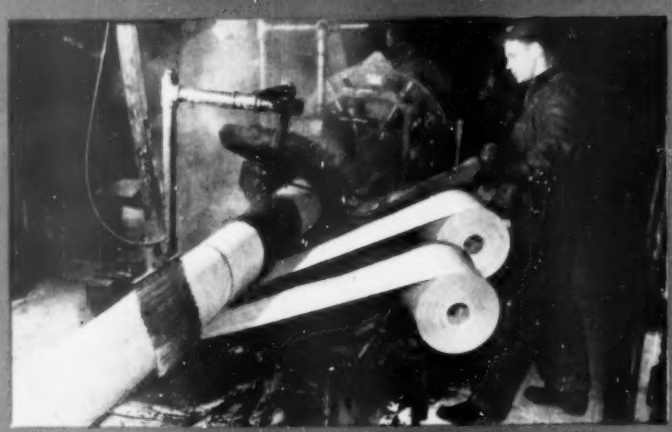

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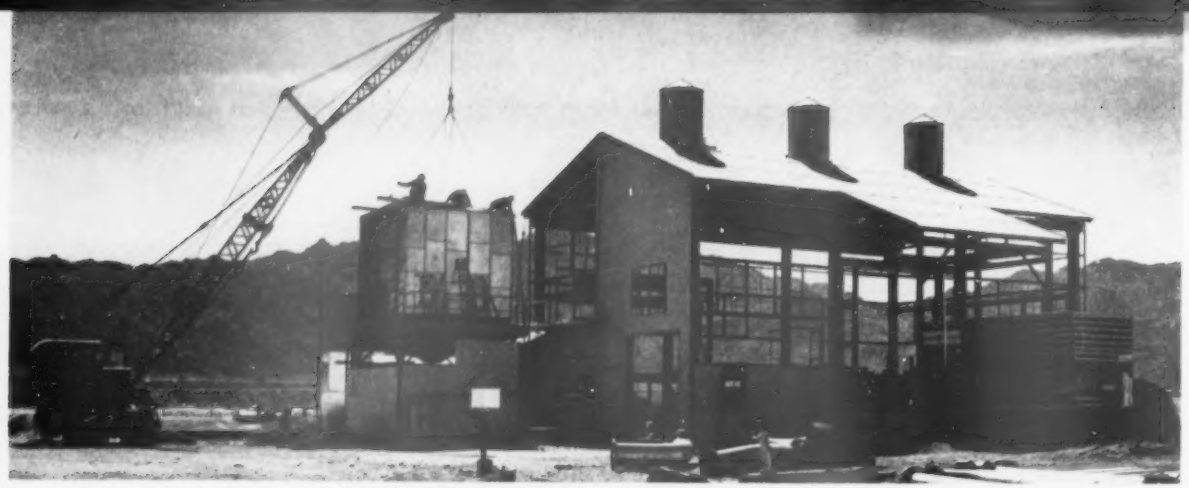


Booster station at Desert Center is nearing completion in current expansion of the Texas-California system which will bring an additional 300,000,000 cu. ft. of out-of-state natural gas to southern California.

Two New Projects Will Boost California Natural-Gas Supply

by F. M. Banks

TWO major pipe-line projects, undertaken to import large volumes of out-of-state natural gas to meet increasing customer demands for fuel, are being rushed to completion by Southern California Gas Co. in cooperation with Southern Counties Gas Co. and El Paso Natural Gas Co.

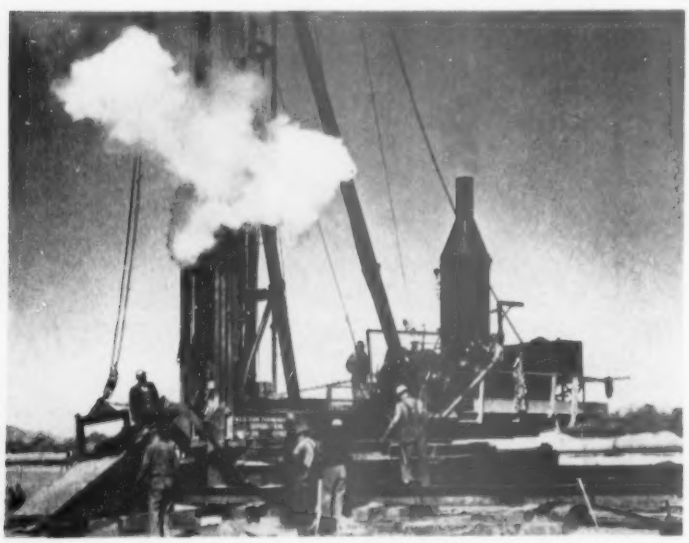
Upon completion of these projects late this year, a total of 705 million cubic feet of natural gas per day will reach gas users in Southern California via the Texas-California pipe line. And another 705 million cubic feet of gas will also go to Pacific Gas & Electric Co., of San Francisco.

In the two pipe-line projects, the Southern California gas companies will spend approximately 12.5 million dollars for pipe-line construction and expansion of compressor-plant facilities. El Paso Natural Gas Co., supplying the gas, will spend about 283 million dollars in construction of additional pipe-line and compressor facilities to move the gas from the Permian basin in West Texas and the San Juan basin in New Mexico and Colorado to the Arizona-California border.

First Phase

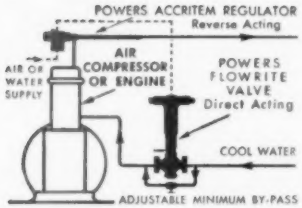
In this phase of the pipe-line expansion program, which was approved by the Federal Power Commission in July 1952, the Southern California companies are constructing two booster stations, one at Desert Center and the other at Cactus City, and expanding compressor-plant facilities at the Blythe compressor station. The two companies are also laying 20.3 miles of 30-in. loop line paralleling the Texas - California pipe line in another phase of the program.

Centrifugal boosters . . . When completed, the two booster stations will be gas-turbine-driven, centrifugal-compressor stations utilizing G.E. 5,000-hp. gas-turbine engines to create a gas



A total of 1,174 piles were driven into the building site and filled with compacted sand in installing foundation for the new compressor building at Blythe. This method was first successfully used in Belgium and Holland.

Additional scrubbers are being installed at Blythe compressor station as part of expansion program of Texas-California Pipe Line system.



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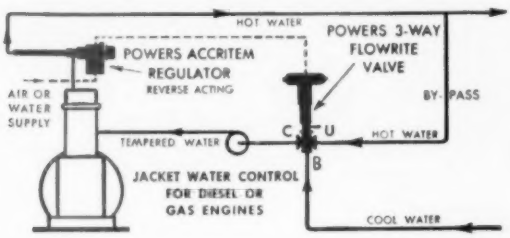
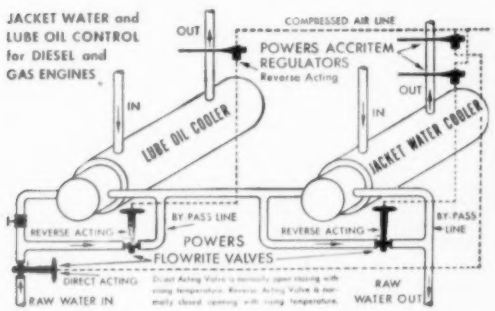


Only a few of many applications are shown here.



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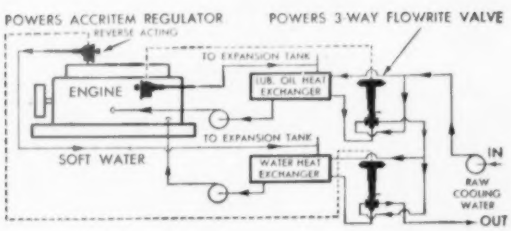

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THE AUTHOR

F. M. Banks, president and general manager of Southern California Gas Co., joined the engineering department of the company in 1922, after securing a degree of bachelor of science in electrochemical engineering from Massachusetts Institute of Technology. He also attended Colorado School of Mines. In 1927 he was placed in charge of the company's operations in the San Joaquin Valley with headquarters in Visalia. Banks remained there until 1930, when he returned to Los Angeles as general superintendent of sales. He became a member of the board of directors in 1934, and the following year was appointed vice president in charge of sales, advertising, and public relations. In 1948 he was named vice president and assistant general manager, and the following year, vice president and general manager.

pressure boost on the pipe line between the Blythe compressor station and Los Angeles.

In addition to the 10,000-hp. of additional compressor capacity provided by the two booster stations, another 3,520-hp. is being added at the Blythe compressor station with the installation of two 1,760-hp. Clark compressors.

The pipe-line expansion in this initial phase of the program calls for construction of 14 miles of 30-in. loop line from Whitewater near Palm Springs, eastward, paralleling and tying into the Texas pipe line. This work was completed early this year. A similar 6.3 miles of loop line has also been laid from the Blythe compressor station to the Colorado River.

Second Phase

The second part of the program to increase deliverability of the Texas-California pipe line involves the laying of 73 miles of 30-in. pipe line, and adding 5,280 additional horsepower at Blythe. Authorization for this work was given in July by FPC and construction will begin immediately to take delivery of the additional gas by January 1, 1954.

This project will provide 150 million cubic feet more natural gas for Southern California users and a similar amount for customers of P.G.& E. in northern California. Upon its completion, the El Paso company will be furnishing a total of 1,400,000,000 cu. ft. of gas a day to California markets. Deliveries to Southern California will total 705 million cubic feet a day by the end of 1954.

El Paso program . . . To supply this ad-

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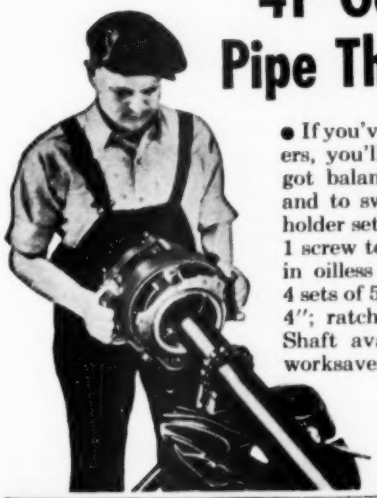

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ditional gas, the El Paso company is adding 1,056 miles of pipe and 162,000 hp. in compressor stations to its system in Texas, New Mexico, Arizona, and Colorado. The Southern California gas companies are laying 73 miles of 30-in. pipe line and adding 5,280-hp. at the Blythe compressor station. And P.G.& E. is installing 227 miles of pipe line and adding 15,000-hp. in compressor stations.

Cost of the new facilities to move the additional gas to California markets will total 175 million dollars for the El Paso company, $7,500,000 for the two Southern California companies, and 26 million dollars for P.G.& E.

The original Texas-California pipe line was built in 1947 with an initial capacity of 175,000,000 cu. ft. of gas a day. Capacity of the system has been steadily increased since that time by installing parallel lines and new compressor stations. The two Southern California gas companies have increased their investment in the 214-mile California portion of the pipe line from an original 12 million dollars to the present investment of about 40 million.

The total investment of all gas companies involved in the Texas-California gas pipe-line project will exceed 500 million dollars by the end of 1954.

Reilly enamel used here

Photo:

Lake Shore Pipe Line, courtesy of the Lake Shore Gas Company of Ashtabula, Ohio.

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Sizing Crude-Oil Pipe Lines

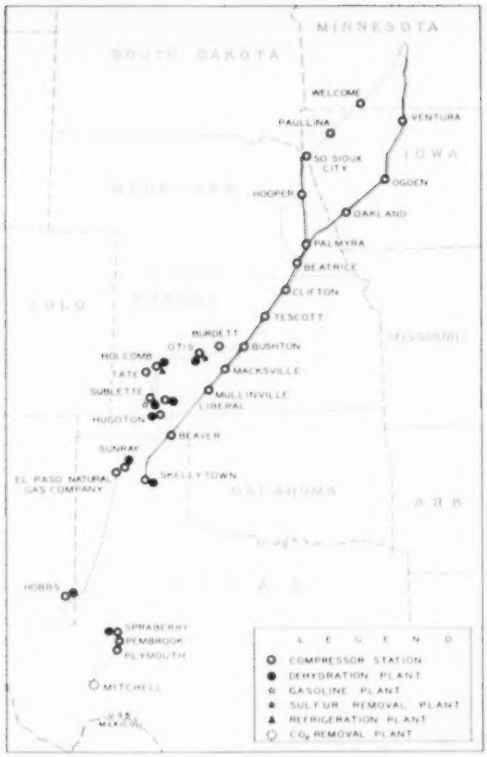
(Continued from page 188)

practical purposes, the curves coincide. This is caused by a balancing effect in the economic calculations. Since the 5LX52 pipe has an optimum pressure higher than that of the 5LX46, fewer stations can be used to pump the same quantity of oil. This higher pressure requires more horsepower per station, making the total horsepower equal to that required when using 5LX46. The difference in investment appears only in the cost of the pipe, which is negligible and does not materially effect the transportation-cost calculations. The factors affecting pipe-line investment tend to offset each other in that more steel is required for 5LX46 pipe but a greater cost penalty is incurred for 5LX52 pipe. The above comparison is based upon identical assumptions, except for the grade of pipe. This relationship is valid only when the minimum wall thickness for each grade of pipe is the same.

If mechanical considerations such as collapse strength, resistance to abuse, etc., justify the reduction of minimum wall thickness for higher-strength pipe, considerable economy can be effected by its use. Although no specific calculations were made for 5LX42 grade of pipe, it is believed that its transportation-cost curve would practically coincide with those of the other two grades under the same conditions. In some special cases in which unusual conditions of terrain and station spacing are encountered, any one of the three grades could prove to be the most economical.

In reiteration, the reader should recognize the limited use of findings in this article. The investigation was limited to what was considered pertinent. The intention was only to bring the curves up to date in accordance with present-day practices and costs.

"It's from th' same aunt that sent me that electric fan when we were up in Alaska fields."



NORTHERN NATURAL GAS CO. and its subsidiary, Permian Basin Pipe Line Co., have scheduled a capacity increase of 272 million cubic feet per day.

LOWERING IN on the 34 miles of 24-in. Plymouth-to-Spraberry line. Rocky terrain of the Permian country makes pipe lining an even rougher job than usual.

BILLION-FOOT CAPACITY BY YEAR'S END

Northern Natural Boosts Three "Firsts" in '53

• First 30-in. pipe • First CO_2 plant • First gas-turbine units

by J. T. Innis

THIS year marks the biggest step forward by Northern Natural Gas Co. of Omaha. Northern will not only pass the billion-foot mark in system salable capacity before the year is over, but this year's 272-million-cubic-foot increase is greater than the entire capacity for the first 15 years of the company's existence.

With capacity planned for 1,007 million by December 1953, and with further boosts to 1,100 million in 1954, Northern will be delivering four times as much natural gas to its market area as it did at the end of World War II.

Costs of this huge expansion program for 1953 alone will total over 100 million dollars including approximately 42 million dollars which will be spent by Northern's subsidiary, Permian Basin Pipe Line Co. Total cost of the 1953-54 construction programs combined will be more than 141 million. This will bring the total expenditure for construction since the end of the war to well over 300 million dollars.

Some "Firsts" for Northern Natural

This year's Northern-Permian expansion program is keynoted by three significant "firsts" for the Northern system. Northern is laying its first 30-in. pipe, the carbon dioxide plant being built by Permian is another first, and two of Northern's three new compressor stations will be equipped with the first gas turbine compressor units on the system.

Previous to the 1953 construction program, the largest diameter pipe used by Northern was 26-in., but this year the company will use well over 200 miles of 30-in. pipe in 10 loop lines. In addition, almost 100 miles of 30-in. pipe will be used on the Permian system.

Carbon dioxide . . . At Mitchell, Tex., on the southern end of the Permian line, Stearns-Roger Engineering Co., of Denver, is constructing the first carbon dioxide-removal plant on the Northern system. Construction of this plant is necessitated by the high content of carbon dioxide in gas from the Permian area. Removal of the CO_2 prevents corrosion of the pipe line in transmitting the gas. First-year capacity of the plant will be 25 million cubic feet daily, but provision has been

BEGINNING OF A COMPRESSOR STATION. This will be the new Spraberry station, the largest of four on the Permian line. The station will have an installed horsepower of 22,400 this year with 3,960 to be added in 1954.

made to expand the plant to a top capacity of 150 million cubic feet daily, which would make it one of the largest of its kind in the United States.

Gas turbines . . . Northern's two new compressor stations located near Macksville and Tescott, Kans., are situated on the main line between large existing stations. Tescott lies between Clifton, Northern's largest station, and Bushton, to the south; Macksville is between Bushton and Mullinville, to the south. Both of these stations will be equipped with three 5,700-hp. gas turbines directly connected to centrifugal compressors.

Advantages . . . These turbines are ideally suited to the new stations because of their combination high flow-low pressure ratio. The turbines will be used primarily to boost large volumes of gas on to the next station for further compression. Among some of the advantages of the gas turbine when used for this purpose are: (1) negligible amount of cooling water; (2) small operating crew; (3) low consumption of lubricating oil, which contributes to low operating and maintenance costs and low installation cost per horsepower, and (4) small physical area per unit which minimizes the expense of buildings. These stations will not require cooling towers for jacket water or for after cooling of gas. The turbines are especially designed for pumping natural gas into pipe lines. Gas from the line is used as fuel for the turbines. The contractor, J. F. Pritchard & Co., of Kansas City, started work on the stations June 1.

Northern Natural System

Northern's market area consists of the five states of Kansas, Nebraska, Iowa, Minnesota, and South Dakota. The company wholesales gas to 27 utility customers serving 230 communities in the area. These figures include Northern's retail division, Peoples Natural Gas, which operates gas distribution systems in 89 communities throughout the five-state market area. The total number of consumers served by Northern's system at the end of 1952 was 659,951.

Physical properties . . . Northern's system consists of over 7,000 miles of pipe line spanning seven states. Located at approixmately 80-mile intervals along the line are 26 compressor stations of which 21 are main-line stations. In addition to these there are seven dehydration plants, a sulfur-removal plant, and two natural-gasoline extraction plants. Northern's 1953 construction program will add over 250 additional miles of main-line pipe line as well as three new compressor stations and additions to more than half of the existing main-line stations. These new facilities will handle the increased volumes of gas which Northern is to receive from all sources including its subsidiary, Permian Basin Pipe Line Co. Northern owns a 55 per cent interest in the company. In terms of capacity, Permian will supply Northern with 200,000,000 cu. ft. per day by the end of 1953, and still another 100,000,000 cu. ft. after 1954's expansion program.

THE AUTHOR

J. T. Innis is a vice president (operations) of Northern Natural Gas Co. He has been with the company since 1930, its incorporation year, and he was present at the time the first joint of pipe was laid on the Northern system. Much of his time with Northern has been in jobs in which he was actively engaged in constructing and building the pipe line. In 1943, he was named general superintendent of operations and in 1950, he was elected to his present position. He is a member of the American Gas Association and is presently serving as chairman of the transmission committee of that organization.

Permian Program

Included in the Permian construction program are four compressor stations, two dehydration plants, one sulfur-removal plant, a carbon dioxide-removal plant, a gasoline plant, and a total of 234 miles of pipe-line system. One of Permian's compressor stations is located 7 miles west of Hobbs, N. M., and the other three will be located in the Spraberry trend of Texas, which is an area where large amounts of residue gas have previously been flared by oil producers.

Of Permian's total of 234 miles of pipe, 34 miles of 26-in. will carry gas from the Hobbs station to a measuring station in Yoakum County, Texas. Most of remaining 200 miles of pipe will bring Permian's gas in the Spraberry trend area to Yoakum County. Permian's system will also include 70 miles of 16-in. line which will run from the Mitchell carbon dioxide-removal plant in Pecos County, Texas, to the compressor stations in the Spraberry trend. The anticipated completion date for the Permian project is December 1, 1953.

Gas source . . . Permian's gas comes primarily from two sources. The company has negotiated a contract to purchase 200,000,000 cu. ft. of gas daily in the Spraberry trend area from Phillips Petroleum Co. This is all residue gas. The remainder of Permian's supply will be dry gas from the Lea County, New Mexico, area to be purchased from 17 producers. Permian's reserves under contract amount to 2.7 trillion cubic feet.

Under the terms of the agreement, between Permian and El Paso Natural Gas Co., which will save 15 million dollars in construction costs, El Paso will reverse the flow of gas in a 203-

mile, 24-in. line which runs from southeast Yoakum County, Texas, in the Panhandle area, where El Paso's Dumas compressor station is located. Northern will build a 14-mile connecting line to its Sunray compressor station to transmit the gas into its system.

Eliminate cross hauling . . . El Paso is currently using its 203 miles of Dumas line to transmit gas in a southerly direction from the Texas Panhandle field into its main-line system in southern Texas and from there to its California market area. As part of the agreement, Permian will deliver to El Paso in the Permian area a maximum of 300,000,000 cu. ft. of gas daily. In turn El Paso will deliver a like amount of gas to Permian at the discharge side of the Dumas station. El Paso will receive payment for gas delivered through its line. This agreement, which eliminates the cross hauling of gas, is expected to start operating in December and will run for 35 years.

Exploration

Aside from construction, Northern is continuing its exploration in search of suitable locations for underground storage near its principal markets. The company conducted exploratory drilling operations in Dallas County, Iowa, this summer seeking desirable geological conditions. Similar drilling has been carried out in southern Minnesota and eastern Nebraska.

The search for new gas supply also continues to occupy a front seat in Northern planning. Northern Natural Gas Producing Co., which was formed in late 1952, is conducting a stepped-up exploration program. Northern continues to maintain its interest in five of the six major basin areas through Mid-North America, including the Alberta basin of Canada and the Williston basin of North Dakota. The company is constantly exploring and negotiating for new supply.

Only recently, Northern entered an agreement with Republic Natural Gas Co. in which it purchased the Republic gathering lines in the Kansas portion of Hugoton field. A second part of the agreement gives Northern the preferential right to purchase gas which Republic may have available in an area including all of North Dakota, South Dakota, Nebraska, and Kansas; and portions of Montana, Wyoming, Colorado, New Mexico, Oklahoma, and Texas.

Northern's expansion plans go far into the future with increases in capacity to 1,800 million cubic feet daily foreseen by 1958 . . . an increase of two and one-half times the capacity at the end of 1952.

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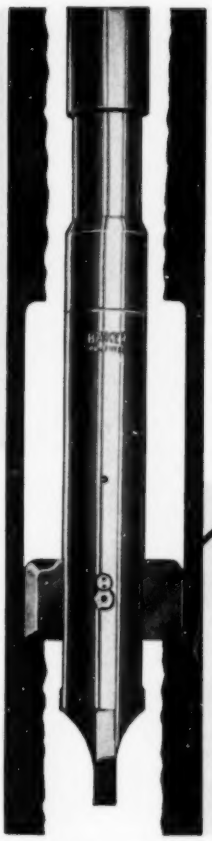

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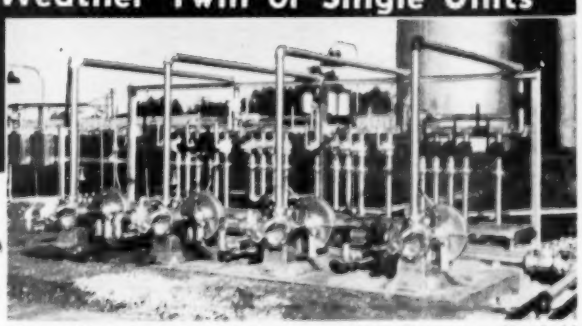

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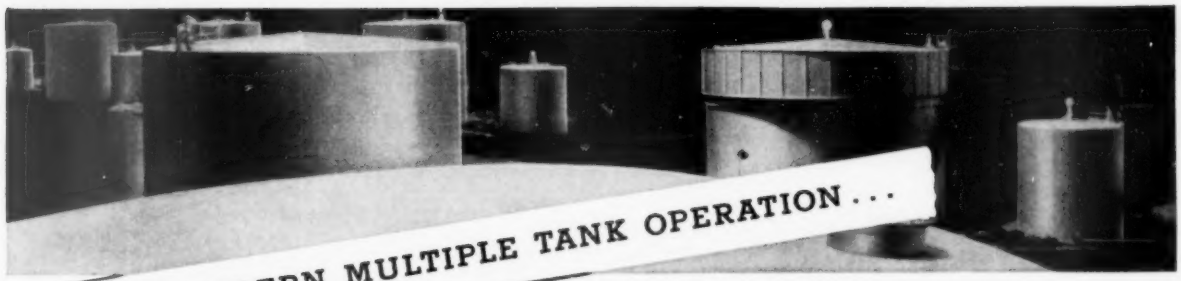

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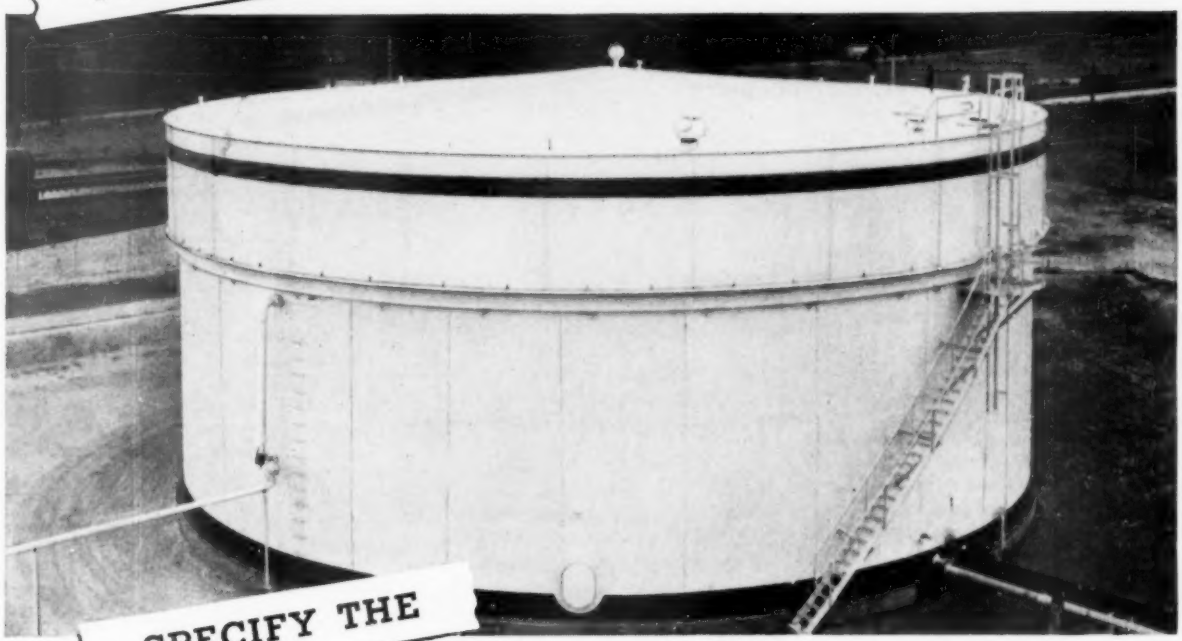

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Gas Transmission and Distribution Piping Code Is Being Revised

by F. A. Hough*

PORTIONS of the American Standards Association Code for Pressure Piping pertaining to gas-transmission and distribution facilities are now undergoing extensive revision and expansion. This code, A.S.A. B31.1-1951, is the generally accepted standard code in the United States and, to an increasing extent, in Canada for the design and construction of power piping, gas and air piping, oil piping, district heating systems, and refrigeration piping.

Revision need . . . As a result of blowouts of gas-transmission lines and failures of gas-distribution facilities, legislation has been enacted in several New England and eastern and middlewestern states, requiring the public-utility commissions in those states to regulate the design, construction, and maintenance of gas-transmission and distribution facilities. And the Heselton bill, which if enacted will give the Federal Power Commission authority to regulate the design and construction, operation, and maintenance of interstate gas pipe lines, has been introduced in Congress.

The American Gas Association therefore requested the American Standards Association to undertake a revision of the code so that it will adequately meet the present requirements of the industry and the public.

The objectives to be accompanied by the revision are:

1. Review the failure record of the industry and make such revisions in the code as seem necessary in the light of that record.

2. Draft the code and expand its scope so that it will be suitable and complete for adoption by reference by government agencies in those cases where legislative bodies consider regulation necessary.

New committee . . . A new A.S.A. committee was formed in June 1952 to prepare the new code. This committee is known as A.S.A. Pressure Piping Code Committee B31, Subcommittee 8 on Gas Transmission and Distribution Piping. It is sponsored by the American Society of Mechanical Engineers and the American Gas Association.

*Vice president, Southern Counties Gas Co. of California, and chairman, A.S.A. B31.1 Subcommittee 8.

All affected industries and the public are represented on this committee. There are approximately 70 members representing gas-transmission companies, gas-distribution companies, pipe and fitting manufacturers, equipment manufacturers, pipe-line contractors, consulting-engineering firms, the Federal Power Commission, the National Association of Railroad and Utility Commissioners, the Petroleum and Natural Gas Branch of the U. S. Bureau of Mines, the U. S. Bureau of Standards, the insurance industry, and one state utility commission.

The committee has employed engineers and metallurgists as consultants from the faculties of M.I.T., Iowa State College, University of California, University of Alabama, and the staff of the Battelle Memorial Institute. Certain associations that have a direct interest in the work of the committee are represented. These include the American Petroleum Institute and the American Gas Association.

In the selection of members attention was given to proper geographical distribution. The gas-industry representatives come from nearly all sections of the United States and from Canada.

During the past year this committee has had six meetings and has completed the first draft of its proposed new code. It has during this period started and in some cases completed the flollowing investigations:

1. Study of causes of pipe-line failures.

All pipe-line failures that have occurred since 1930 and have been reported to the committee have been studied as to their basic causes. This work was done under the direction of Stephen A. Bergman, assistant chief engineer, Panhandle Eastern Pipe Line Co., with the assistance of Battelle Memorial Institute.

2. Suitability of present pipe specifications.

Present pipe specifications have been critically examined in the light of recent experience in the industry, notably in connection with the failure of round-seam welds and the long failures that occurred during the testing of one recently completed pipe line.

This work has been done under the direction of C. F. de Mey, vice president, Columbia Gas System Service Corp., with the advice and assistance of metallurgists from the pipe-manufacturing industry and from the faculties of M.I.T., University of Alabama, and University of California, and members of the staff of Battelle Memorial Institute.

3. An investigation of the brittle behavior of pipe-line pipe.

This is a two-pronged investigation including the laboratory determination of the impact properties of a large number of samples of pipe steel and field experimentation to determine the conditions under which brittle fracture occurs in pipe lines. This work is being done in collaboration with the pipe manufacturers. Laboratory work is being done at the Armour Research Foundation, and the field work is being done under the direction of Battelle.

4. Investigation of automatic main-line valves.

5. Investigation of the problems connected with the hydrostatic testing of pipe lines and the field conditions under which this type of testing should be employed.

The trend of the thinking of the committee seem to indicate that:

1. No basic change in the design procedure prescribed by the present code is anticipated. Permissible working stresses will be expressed as percentages of the specified minimum yield strength of the pipe, as in the present code, and the design will be based upon the nominal wall thickness of the pipe, as in the present code, rather than upon the minimum wall thickness.

2. No major change in permissible stress levels is anticipated.

3. The revised code will probably be more restrictive as to the type of pipe that can be used at high stress levels. The present code imposes a joint efficiency on all welded pipe (unless stress relieved and radiographically examined), but provides an escape clause which permits rating any pipe at 100 per cent joint efficiency if an unspecified number of supplementary tests are made to demonstrate that the weld is equal in strength to the specified minimum yield strength of the pipe.

It is probable that the new code will not contain such escape clauses but will permit the rating of certain types of welded pipe at 100 per cent efficiency if the strength of the weld of each length has been demonstrated by the cold expansion process.

4. The revised code will prescribe that all gas-transmission and distribution facilities intended to operate at high stress levels shall be tested prior to being placed in operation to demonstrate the adequacy of the strength of the installation. It will also be prescribed that this test must be conducted

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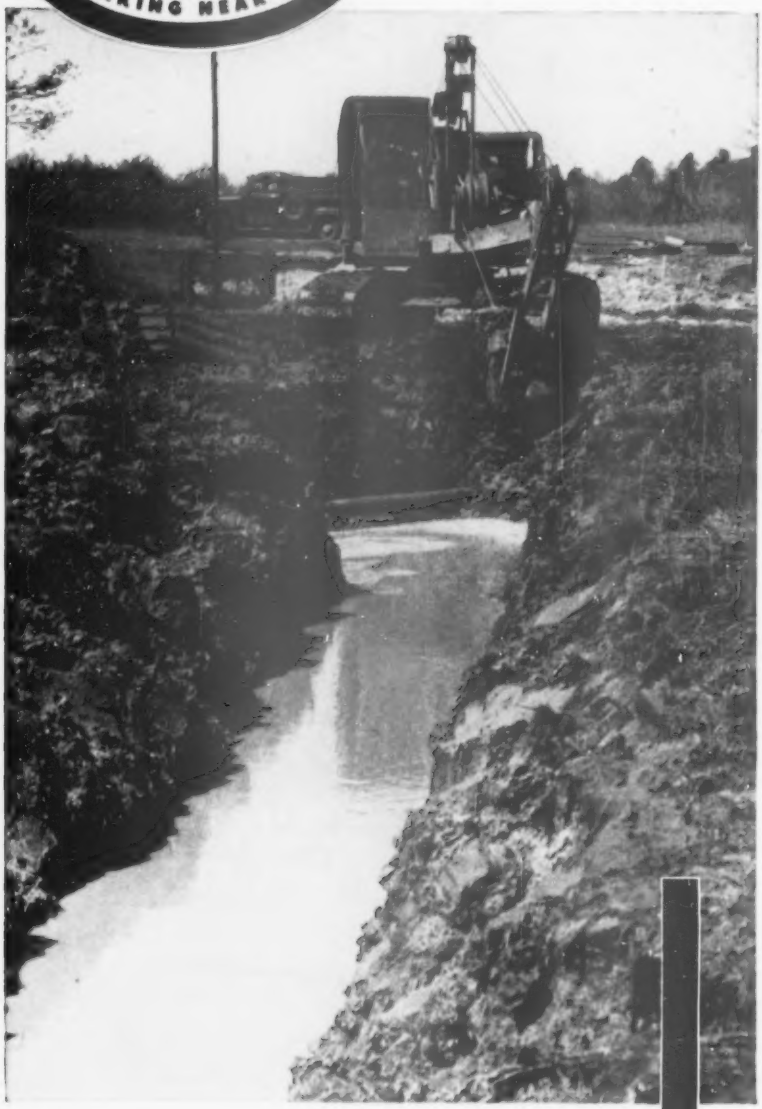

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in a manner which will not endanger the lives of the public or employes performing the test.

5. The revised code will prescribe that posiltive means must be provided for preventing the accidental overpressuring of pipe lines and distribution facilities.

6. The revised code will contain a new and more extensive coverage of design details that are all-important from a safety angle.

7. The revised code will emphasize the importance of avoiding or eliminating notches, grooves, and cracks in highly stressed pipe lines and the importance of using steels that are not overly sensitive to such defects.

8. The revised code will emphasize, as does the existing one, the importance of adequate quality control of field welding.

9. The revised code will require either the elimination of important corrosion or the making of liberal provisions in the design for corrosion if corrosion is not to be prevented.

10. Operating and maintenance procedures that are necessary to keep an operating transmission or distribution facility safe will be covered.

11. The revised code will cover in some detail design matters affecting safety in compressor stations.

It is hoped that the revised code will be ready for publication early in 1954.

Sinclair Crude Line Crosses 31 Streams

(Continued from page 177)

THE AUTHOR

J. D. McConnell, general manager of crude oil lines, Sinclair Pipe Line Co., Independence, Kans., was born in Minnesota and educated in electrical engineering at University of Wisconsin. As junior engineer he began his pipe-line career in 1920 with Prairie Pipe Line Co., predecessor of Sinclair Pipe Line Co. While serving as civil engineer, district foreman, assistant division superintendent, and administrative assistant he had extensive experience in valuation work, surveying, pump-station design, and pipe-line construction and maintenance. In November 1951 he was placed in charge of construction of Sinclair's Cushing-Chicago big-inch project.

form 80-ft. lengths was done at a yard near the river, entirely by manual welding.

All of the work at the Mississippi River crossing took about 2 months between August 4 and October 6, 1952.

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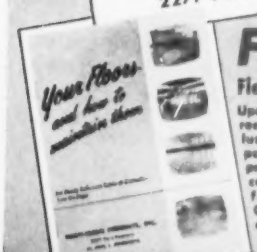

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Actual laying from barge was done in a month, beginning September 7.

A 134-ft. casing was installed for the pipe under a railroad and highway between a steep hill and a dike at the east side of river bottom.

In crossing 4 miles of bottom lands where there were numerous drainage canals, 1,000 river clamps were used. In this area there was danger of damage from sand boils which might displace the pipe.

Dredging was done alongside the line after laying so that the line fell into place in the trench in the customary way. The ditch had to be backfilled and all spoil piles distributed with dredge to restore channel to its original depth.

The Illinois River's 2,700-ft. crossing includes 1,100 ft. of standard-weight pipe laid beyond the area of the river itself. Approximately 1,600 ft. of ½-in.-wall pipe was laid in the river at a depth of 15 ft. below water level of the LaGrange pool stage. The pipe had a minimum of 4-ft. cover at the low point in the channel.

At the Illinois River the line crossed through the levee at a point above the flood level. The levee was cut to form a ditch for the pipe line. "Seepage ring" baffle plates were installed but no casing was used.

Compaction tests were made at the levees by the drainage district engineers after backfilling.

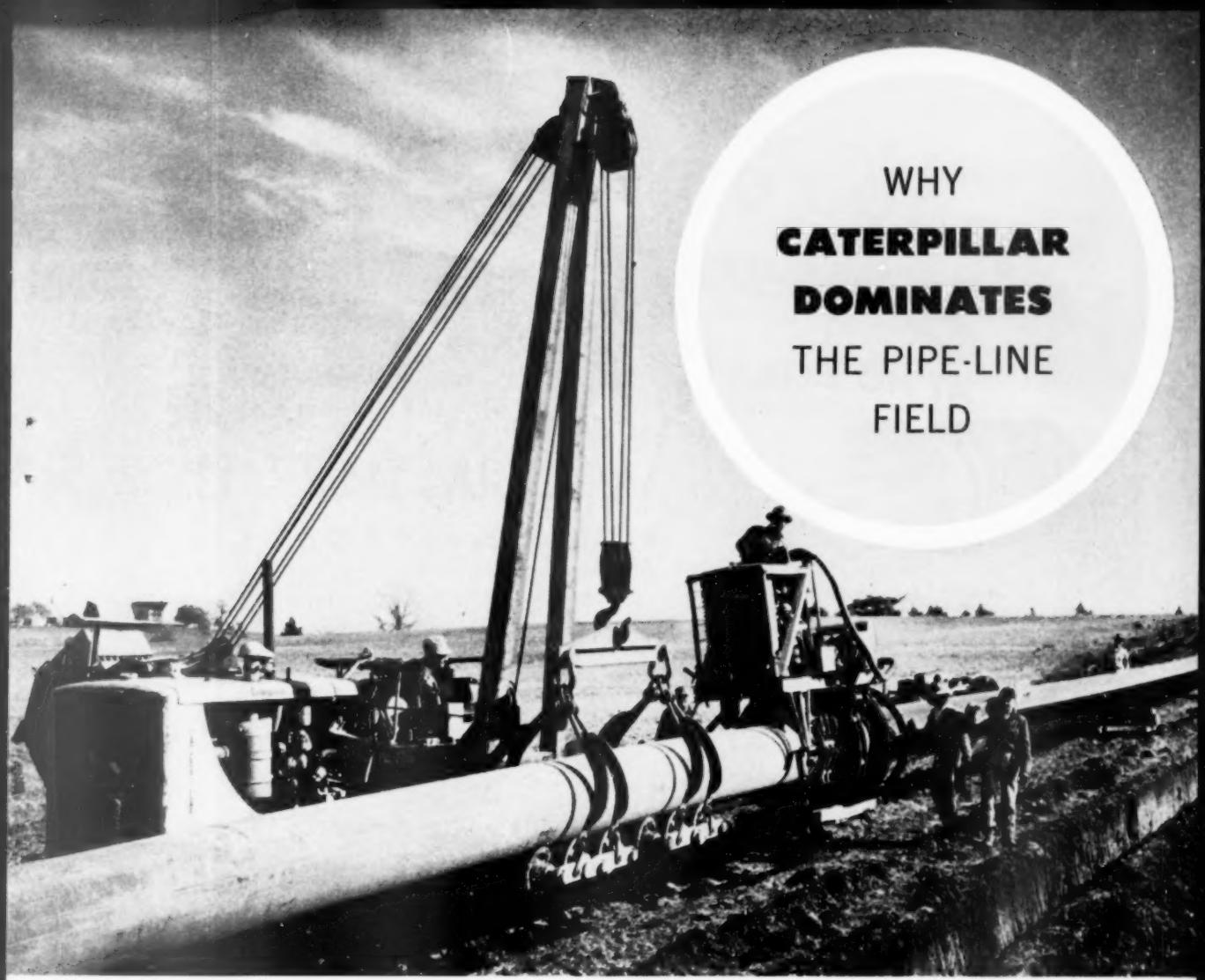
The pipe was pulled across the Illinois River in two sections; one 900 ft. and the other 700 ft. Pulling was done by a winch on the west side. The sections were launched from dollies on railroad tracks on the east side. The same method was used for pulling the long sections at the Arkansas and Missouri rivers for this project.

The five major river crossings were contracted as follows: Cimarron and Arkansas rivers by O. R. Burden Construction Corp.; Missouri River by C. S. Foreman Co.; Mississippi River by Penzien, Inc.; and the Illinois River by Missouri Valley Dredging Co.

BOOK

LUBRICANT TESTING. By E. G. Ellis. Published by Scientific Publications (Great Britain) Ltd., 8, Walker Street, Wellington, Shropshire, England. 232 pp. 37s.6d.

This book should be of help to beginners in various industries, chemists in various industries whose primary concern is with products other than lubricants, and non-chemical personnel such as engineers and salesmen who wish to acquire some insight into the significance and application of the tests used in the standardization and investigation of oils and greases. The tests considered have been grouped under three main headings: Fundamental Properties, such as density, viscosity, etc.; Composition; and Investigation of Behavior, which includes functional testing.



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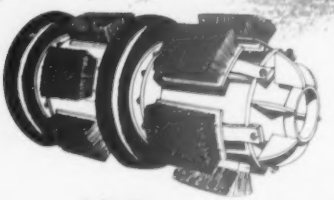

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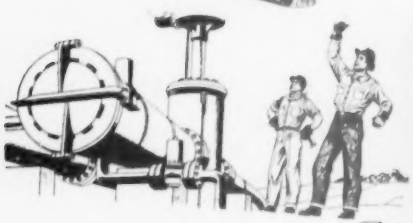

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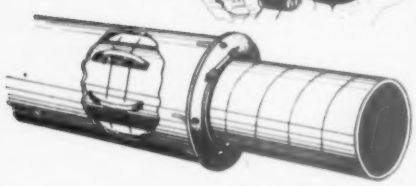

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NIPPLE with ½-in. wall welded to top of 26-in. pipe.

A SADDLE of ¾-in. wall reinforces the nipple.

A FLANGE is welded to the nipple.

A 20-IN. VALVE is bolted to the flange.

VALVE IN POSITION ready for tapping.

BOOM TRACTOR placing tapping machine on valve.

How Creole Petroleum made a

Hot Tap for Big-Inch Crossover Connection

by J. M. Lewis*

DURING construction of Creole Petroleum Corp.'s second 145-mile, 26-in. crude-oil line running from Ule in the producing area of Lake Maracaibo to the Amuay refinery on Paraguana Peninsula, Venezuela, the management of the company foresaw the need for providing crossovers between the two lines on both shores of the Gulf of Coro.

Installation connections for two 20-in. crossover lines was accomplished successfully in approximately 3 days at each of the two locations by the contractor, Williams Brothers Co. While the live line was tapped, flow of crude to Amuay continued uninterrupted.

At the time the crossover piping was installed in January 1953, the first 26-in. line had been in operation 4 years and the laying of the second one had been recently finished but it had not been filled with oil.

*Engineer, Williams Brothers Co., Tulsa.

bundles for production

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FIRST ... to use vanishing threads; to improve the curve of the upset ends into the body of the rod; to use nickel-molybdenum steel; to normalize and temper the rods throughout their entire length.

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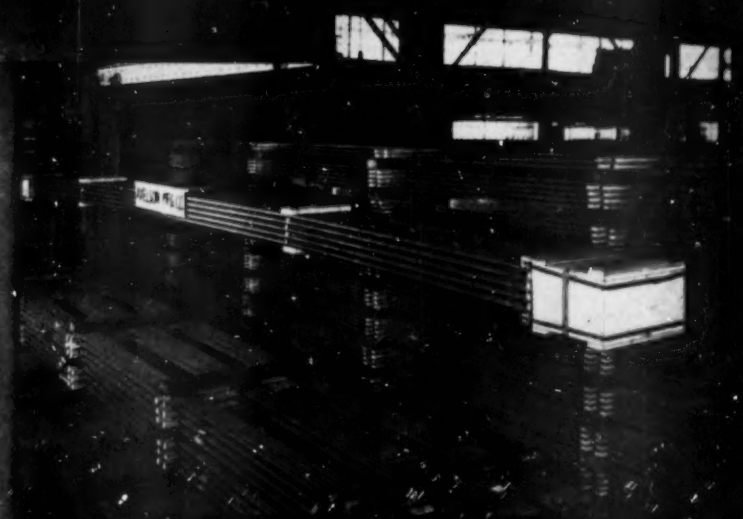
PR-24

Short haul: Sucker rods pallet mounted, 4 lateral braces bolted to truck bed.

Long haul: Sucker rods pallet mounted, 4 lateral braces bolted to car bed, and metal strands guyed to prevent shifting.



Export: Sucker rods pallet mounted, 4 lateral braces bolted, with upset ends crated for complete protection.

By installing the crossover lines in this way, two problems were solved for Creole. In the first place, the company needed crossovers so that in an emergency it would be possible to pump the throughput of both the 26-in. lines through one of the two 15-mile submarine lines across the Gulf of Coro. Unless provision were made in advance of trouble, it was anticipated that inevitable delays at the time of trouble would be very costly.

The second requirement of Creole was to install the crossover without shutting down the live line for the installation of two tees in the usual way. An interruption of flow in the 300,000-bbl. capacity line to Amuay would have disrupted crude-oil supply schedules. Actual installation operations met this requirement. For even while the line was being cut, it was operated at full throughput. Pressure in the line was 200 psi. at the mainland location and 100 psi. at the peninsular location. The nearest pump station is at Dabajuro, approximately 45 miles upstream.

When confronted with the problem of tapping a live 30-in. line, Williams Brothers' staff recognized the importance of performing the operation with dependable equipment because a large amount of oil might have been spilled at the shore in case of a break.

A new model No. 1200 Williamson-Hillco tapping machine was procured for the undertaking. This is the first large-diameter high-pressure tapping machine. It is operated by a Vickers hydraulic motor mounted on a gear case and connected by two hoses to a pump driven by a gasoline engine. The pump maintained pressure at 800 to 900 psi. during cutting operations. The bare unit weighs 1,300 lb. Prior to shipping to Venezuela, it was tested at 1,000 psi. in the Williams Brothers shop at Tulsa with the same series of flanges as required on job location.

Preparations took much more time than the actual tapping operations. It was important that the nipple and saddle be tight and rigid. The top rim of the nipple had to be absolutely level and smooth to provide correct alignment of the flange. After the nipple with ½-in. wall was welded to the top of the 26-in. pipe, it was reinforced by a saddle of ¾-in. wall placed over it and welded. All of this welding was done in 1½ days in spite of a 30-mile wind.

The second step was the setting of the Walworth 20-in. A.S.A. Series 600 valves by bolting onto the flange of the "simulated tee." This operation, together with the hydrostatic test of the valve seat, took about half a day. The valve was insulated to prevent corrosion.

The tapping machine was installed on the valve and bolted by an adapter flange. Boring operations started with the puncturing of the pipe by a pilot drill. Time consumed for the actual cutting of the 19-in. coupon from the pipe with a 20-in. shell cutter rotating at 23 r.p.m. was 1 hour and 10 minutes.

At the end of the tapping operation the pilot drill retrieved the coupon by means of a spring-loaded ball device which held the coupon firmly. After the coupon was lifted to the upper part of the valve chamber, the valve was closed and the chamber was drained by small piping installed for this purpose.

Setting up and removing the tapping machine took half a day at both crossover locations.

Following the removal of the tapping machine and the adapter flange, the remaining connections for the crossover line to the empty line under construction were made according to customary practices.

Tapping operations and the incident welding took approximately the same time at locations on both sides of the Gulf of Coro.

Successful experience with this operation demonstrated that the tapping of a large-diameter line operating with full throughput can be done satisfactorily with adequate equipment and preliminary preparations.

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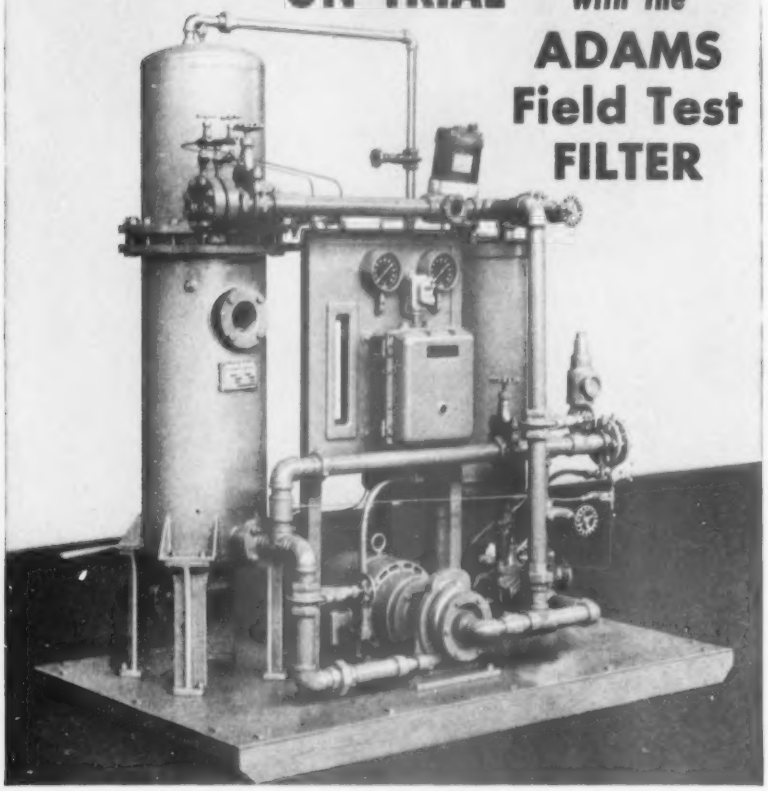

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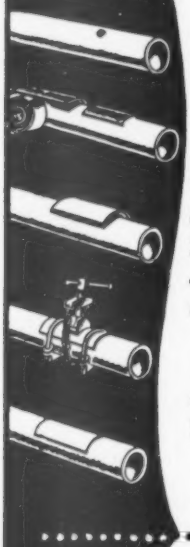

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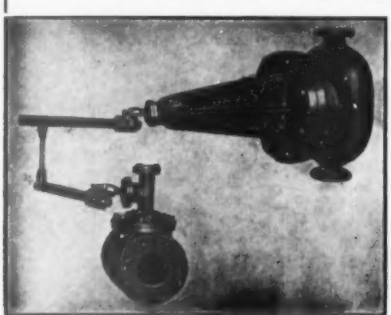

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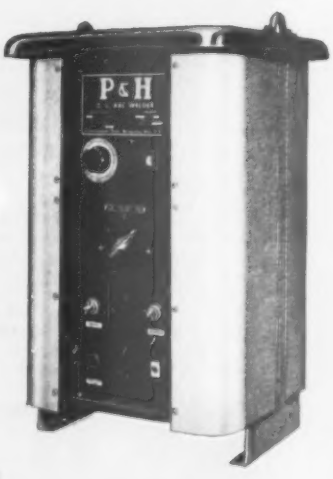

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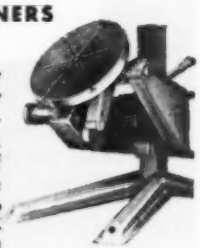

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How to Size Tank-Farm and Delivery Lines

(Continued from page 180)

$$EP_1 = L_1K_1 (Q/C)^{0.54}$$

In the second section:

$$EP_2 = L_2K_2 (Q/C)^{0.54}$$

The total pressure for the section would be:

$$EP_1 + EP_2 = EP = L_1K_1 (Q/C)^{0.54} + L_2K_2 (Q/C)^{0.54}$$

Solving this equation for Q:

$$Q = C [EP/(L_1K_1 + L_2K_2 \text{ etc.})]^{0.54} \quad (3)$$

The values of K for the pipe sizes in the system can be taken directly from Chart 1. Chart 3, which converts values of $[EP/(L_1K_1 + L_2K_2)]$ to the 0.54 power is included.

Example: Assume a single line consisting of 10 miles of 10-in. pipe and 15 miles of 8-in. pipe. The quantity which could be pumped through this line, assuming both ends of the line were at the same elevation, with 1,000 psi., would be calculated as follows:

Using Equation 3:
- $C = 140$ (for gasoline)
- $EP = 1{,}000$ (given)
- $L_1 = 10$ (given)
- $L_2 = 15$ (given)
- $K_1 = K_{10"}$, from Chart 1 $= 0.12$
- $K_2 = K_{8"}$, from Chart 1 $= 0.3655$
- Q to be determined

Substituting in Equation 3:

$$Q = 140 [1{,}000/(10 \times 0.12 + 15 \times 0.3655)]^{0.54}$$

The term within the brackets: $[1{,}000/(10 \times 0.12 + 15 \times 0.3655)]^{149.7}$

From Chart 3, $(149.7)^{0.54} = 15$.

Therefore: $Q = 140 \times 15 = 2{,}100$ bbl. per hour.

The method of equivalent lengths may be preferred by many engineers for the solution of a problem where different sizes of pipe are involved. However, since the equation for sizing tank lines is a variation of Equation 3, it was considered appropriate to include it here.

Delivery and tank lines . . . Here the problem becomes one of determining the proper pipe sizes for lines of given length at a predetermined pumping or delivery rate.

Solving Equation 3 for K_1, the formula can be written:

$$K_1 = (C/Q)^{0.54} \times EP/L_1 - L_2K_2/L_1 \quad (4)$$

In this equation, the terms have the same identity as those in Equation 3. Chart 4 to convert the ratio C/Q to $(C/Q)^{0.54}$ is included for convenience. In the following section it will be shown how Equation 4 can be used handily in the sizing of delivery lines and tank-farm lines.

SIZING DELIVERY AND TANK-FARM LINES

When the problem of sizing lines between the takeoff terminal and the tanks arises, the tank farm has already been located and the location of the tank-farm manifold has been established. This establishes a definite value for L_1 and L_2 in Equation 4. From the design of the pipe line, the maximum delivery rate for which the pipe line is designed gives a value for Q. It is logical to assume a value of 140 on gasoline for "C" for new pipe. In designing delivery lines at pipe-line delivery points, the calculations should be based on the maximum rate for gasoline. When diesel fuel is delivered, the pipe-line delivery rate will decrease to such an extent that the facilities so designed will be adequate.

As has been noted, the allowable back pressure against the pipe-line terminal is 45 psi. For a 40-ft. tank (height) the maximum tank head would be 40 ft. Therefore, this figure plus or minus the difference in elevation between the pipe-line terminal and the tanks multiplied by the factor 0.315 (for 0.73 specific gravity gasoline) and subtracted from 45 psi. would produce the value for EP for Equation 4. It is then only necessary to calculate values for K_1 and K_2. The next step is to assume a size of pipe for the manifold piping and solve for the K factor for the delivery line.

Example—Assume:
- $C = 140$.
- $Q = 5{,}000$ bbl. per hour.
- L_1 = distance from pipe-line terminal to tank-farm manifold = 0.46 mile.
- L_2 = distance from tank-farm manifold to farthest tank = 0.08 mile.
- $EP = 45 - (40 \times 0.315) = 32.4$ psi.*

*Note: It is assumed that delivery terminal and tanks are at the same elevation.

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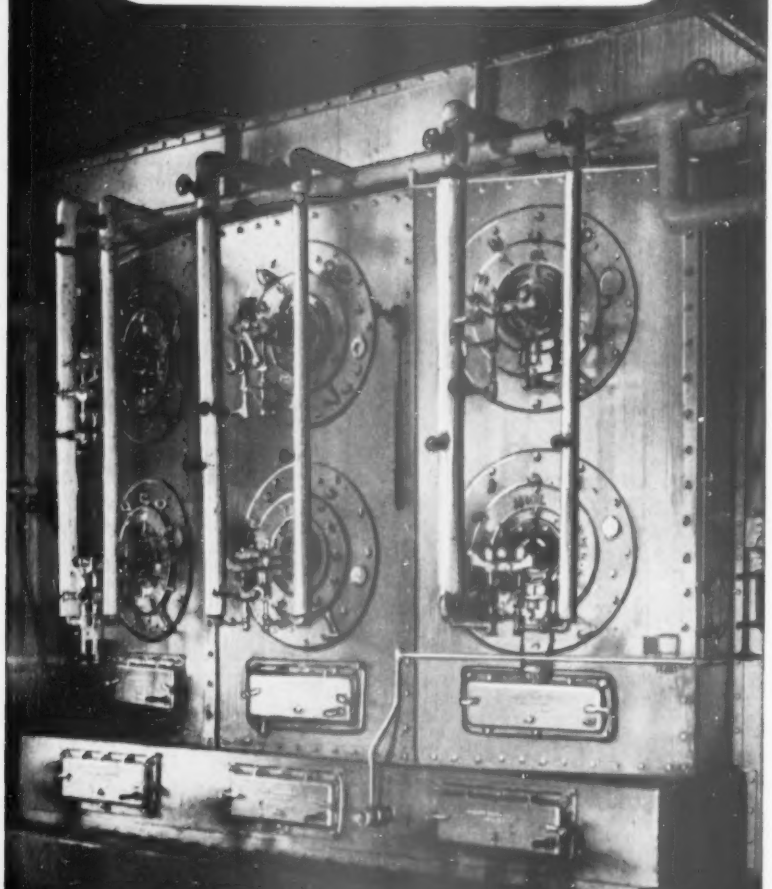

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K_1 = size of delivery line, to be determined.

K_2 = size of tank lines, assumed to be 8 in. From Chart 1, $K_{8"} = 0.3655$.

Solution:

Equation 4 becomes:

$$K_1 = (140/5{,}000)^{0.54} \times 32.4/0.46 - \frac{0.08 \times 0.3655}{0.46}$$

The ratio $140/5{,}000 = 0.28$.

From Chart 4: $(0.028)^{0.54} = 0.0013$.

Substituting these values in Equation 4, we have:

$$K_1 = 0.0013 \times 32.4/0.46 - \frac{0.08 \times 0.3655}{0.46} = 0.03792$$

From Chart 1 0.03792 is seen to be the K factor for 12.8-in. pipe. As the next higher standard size is 14-in., this size would be selected for the delivery line.

The next step is to assume a larger size for the tank lines and solve for the delivery line K factor, exactly as above.

Example: Use same values for all factors, except use K for 10-in. pipe for the term K_2.

From Chart 1 K_2 for 10-in. = 0.12.

The equation then becomes:

$$K_1 = 0.0013 \times 32.4/0.46 - \frac{0.08 \times 0.12}{0.46} = 0.071$$

From Chart 1, 0.071 is the K factor for 11-in. pipe, therefore, 12-in. is required for the delivery line, if 10-in. tank lines are laid.

It is then only necessary to calculate the relative costs of the two installations, and to decide which is the cheaper.

Of course, if a very complicated manifold is built in the tank farm, including strainers, air eliminators, and meters, it is necessary to calculate the drop across the manifold itself and deduct it from the available pressure.

Marine-Terminal Calculation

For calculating line sizes at marine terminals, the procedure is the same except that the facilities should be designed for the heaviest fuels to be handled instead of for gasoline. Differences in elevation between ship and tanks, which usually exist, cut down the available pressure. However, this is partially offset by the increased head

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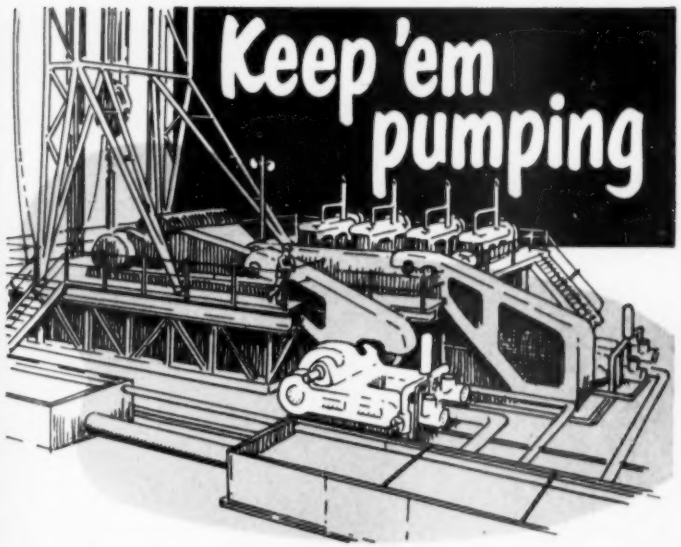

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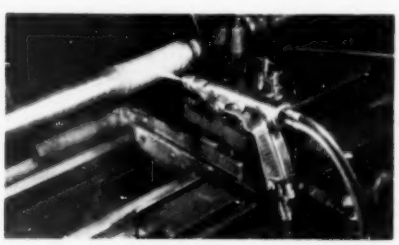

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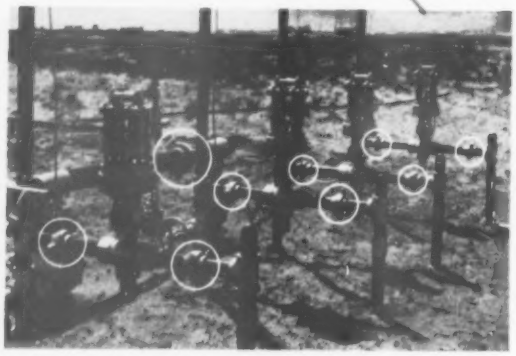

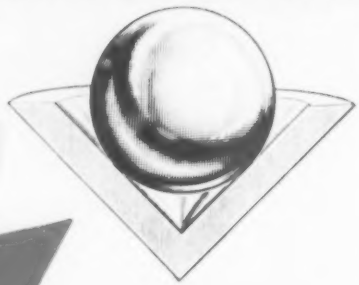

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To illustrate the solution of the problem for a marine terminal, the following conditions are assumed:

$C = 125$ (for diesel fuel).

$Q = 10{,}000$ bbl. per hour (desired delivery rate).

L_1 = distance from ship to tank-farm manifold = 0.46 mile.

L_2 = distance from tank-farm manifold to farthest tank = 0.08 mile.

(EP) = head put up by ship's pumps at 10,000 bbl. per hour on diesel fuel, less tank head and difference in elevation (static head). Assuming a 50-ft. difference in elevation and a 40-ft. tank:

$$EP = 85 - (50 + 40) \times *0.359 = 52.7$$

K_1 = K for size of delivery line, to be determined.

K_2 = Assume 13½-in. i.d. tank lines (14-in. pipe, ¼-in. wall thickness) from Chart 1:

$$K_{13.5"} = \dagger 0.029$$

Equation 4 becomes:

$$K_1 = (125/10{,}000)^{0.54} \times 0.73/0.83 \times 52.7/0.46 - \frac{0.08 \times 0.029}{0.46}$$

The ratio $125/10{,}000 = 0.0125$.

From Chart 4, $(0.0125)^{0.54} = 0.0003$.

Therefore:

$$K_1 = 0.0003 \times 52.7/0.46 \times 0.73/0.83 - \frac{0.08 \times 0.029}{0.46} = 0.025$$

From Chart 1, 0.025 is K for 13.8-in. pipe, therefore 14-in. o.d. pipe is only 0.3 in. too small. It would probably suffice.

Then assume a 16-in. (15½-in. i.d.) delivery line and solve for the tank line size:

In this problem let:

*Static head per foot for 0.83-gravity diesel fuel.

†In order to adjust for the fact that Chart 1 shows the value of K for gasoline, specific gravity 0.73; the ratio 0.73/0.83 is put in the first term of Equation 4 for diesel fuel, specific gravity 0.83.

$C = 125$, as before.

$Q = 10{,}000$ bbl. per hour, as before.

L_1 = distance from tank-farm manifold to farthest tank = 0.08 mile.

L_2 = length of delivery line = 0.46 mile.

K_1 = K for tank lines, to be determined.

K_2 = K for 15½-in. pipe, from Chart 1, = 0.015 and in Equation 4:

$$K_1 = 0.0003 \times 52.7/0.08 \times 0.73/0.83 - \frac{0.46 \times 0.015}{0.8} = 1.65$$ and

from Chart 1, 1.65 = K for 9½-in. pipe.

Therefore, with a 16-in. delivery line, the tank-farm manifold and fittings could be 10-in.

Drop Across Fittings

It is worth emphasizing again that if the tank-farm manifold is to contain several 90° turns and fittings, it is necessary to calculate the drop across these fittings, and subtract it from the available head. At very high rates of flow, this becomes an important factor.

A rough, rule-of-thumb method of figuring the pressure drop across ells and valves is as follows:

1. For each 90°, long-radius ell, add 1 ft. to the length of the line for each inch in diameter of pipe.

2. For each gate or plug valve, add ½ ft. to the length of the line for each inch in diameter of pipe.

For example, assume a 14-in. delivery line of length 2,500 ft. with two 90° ells and two 14-in. valves in the line. To provide for the drop through the ells, add $2 \times 14 = 28$ ft. For the valves, add $2 \times ½ \times 14 = 14$ ft. Length of line then becomes $2{,}500 + 28 + 14 = 2{,}542$ ft. Mitered bends have approximately five times more pressure drop than 90° L.R. ells. They should not be used in manifolds if possible to avoid it.

It should be kept in mind, also, that standard pipe sizes up to 12-in. indicate the inside diameter of the pipe, while above 12-in., the size indicates the outside diameter. For example, 12-in. pipe usually has an inside diameter of 12 in.; whereas 14-in. pipe has an inside diameter of 14 in. less twice the wall thickness of the pipe.

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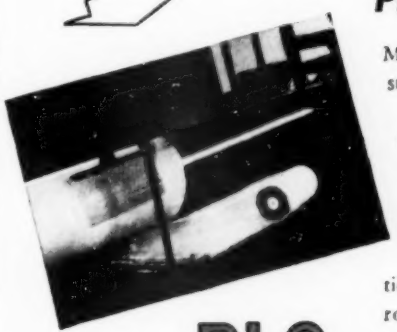

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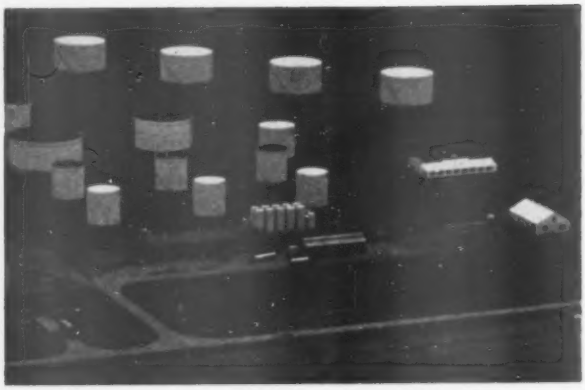


McPHERSON TO COUNCIL BLUFFS... The 227-mile, 6-in. N.C.R.A. products pipe-line system is operated automatically from the dispatching office at McPherson. Fig. 1.

N.C.R.A. Products Line NOW Automatic

Remote-controlled booster stations on Kansas-Iowa products artery

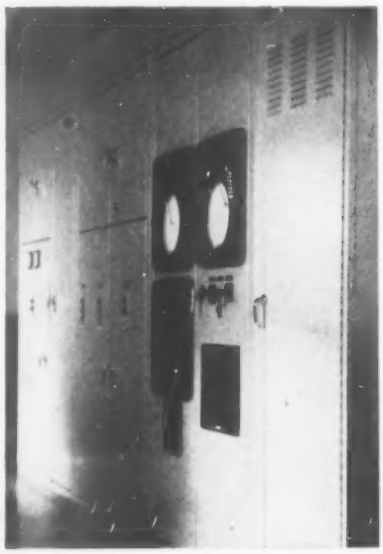
by L. N. Young

THIS article describes the National Cooperative Refinery Association products pipe-line installation which includes three remote-controlled booster stations. The line is operated by a leased telephone wire system which is controlled at the main station, adjacent to the N.C.R.A. refinery, at McPherson, Kans. A dispatcher operates the system from McPherson. One man, doing other work in the vicinity of each of the booster stations, may occasionally take time to check the station. Previously 11 men were required at the three booster stations to keep the line in operation.

The N.C.R.A. operates a 6-in. remote-controlled products pipe line from McPherson, Kans., refinery to terminals located at Council Bluffs, Ia., and Irvington, Nebr. The 6-in. line was built in 1941 with provisions for booster stations at Abilene, Kans.; Blue Rapids, Kans.; and Tecumseh, Nebr.

In 1942 a booster station was constructed at the Blue Rapids station site. Two pumps were used at this station, one being a two-stage centrifugal pump connected to a 100-hp. electric motor, the second, an eight-stage centrifugal pump with a 200-hp. electric motor. These pumps were connected in series for manual operation.

It became necessary by mid-1950 to consider increase of line capacity to an average of 12,500 bbl. per day. In this connection a study was made as to possibility of incorporating remote-controlled stations. To obtain the increased capacity, it was noted that it would be necessary to operate with a maximum pressure of 1,200 psi. occasionally while pumping material ranging in specific gravity from .72 to .82.



TELEMETERING and control equipment is housed in these cabinets. Shown are the Bailey electronic transmitters which keep a continuous record of suction and discharge pressure at each station. Below these is the Bailey scanner which reads the pressure at each station as it is tied in through the telemetering system. Fig. 2.

Communication

The N.C.R.A. teletypewriter system was modified to provide telemetering service in addition to the present teletypewriter communication between McPherson, Abilene, Blue Rapids, Tecumseh, and Council Bluffs. This telemetering service, designed and installed by American Telephone & Telegraph Co. for N.C.R.A., enables the dispatcher to determine the status at certain stations and to control the operation of the stations.

The telemetering control equipment is housed in a cabinet located in the control house at each pump station. Relays, an automatic transmitter, a rectifier, a telegraph repeater, and a test circuit constitute the telemetering equipment. This equipment is connected to the General Electric starting and protective equipment and Bailey pressure instrument. Operation is controlled by the dial signals sent by the dispatcher at McPherson.

Code system... The receiver selector at each pump station is arranged to respond to four separate codes as follows:

1. Motor Start Code

By dialing at McPherson, the pump motor at one of the stations may be started. Upon receipt of the motor start code, the control relay circuit operates and locks up a power relay. The contacts of this relay close a circuit to the suction valve relay circuit,

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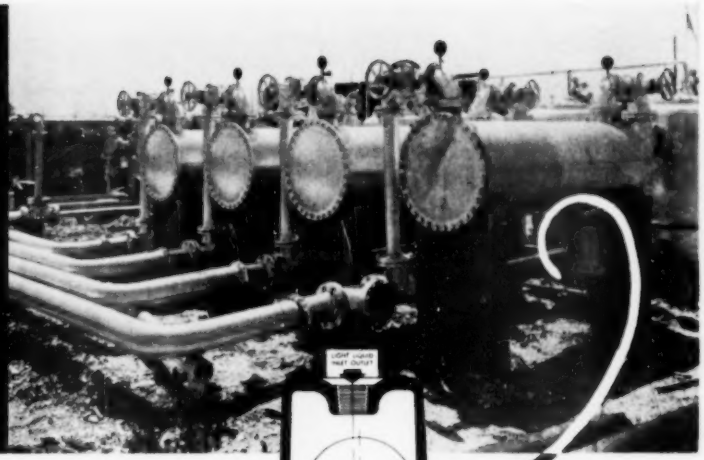

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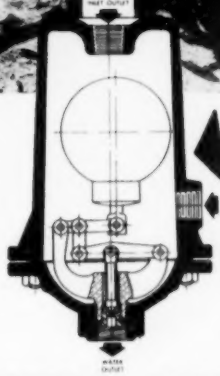

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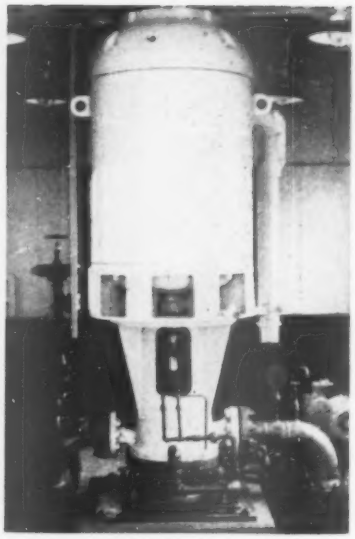
DIALING FROM McPHERSON . . . Abilene station, the first booster station downstream, can be started from McPherson dispatching office. Fig. 3.

CONTROL . . . Instrument board at McPherson. Included on board is a three-pen pneumatic pressure recorder. This records suction pressure to station, discharge pressure of primary pump and discharge pressure of station. Fig. 4.



VERTICAL PUMP . . . At Abilene and Tecumseh stations this 300-hp. vertical motor is employed to drive a 20-stage vertical centrifugal pump. The pump itself is set below ground level. Fig. 5.

which in turn will start motors at the pump station.

2. Motor Stop Code

Upon receipt of the motor stop code, the control relay circuit will release the power relay, which in turn opens the circuits to the pump motor start circuits. This will turn off the pump motor and close the suction and discharge valves, thus taking the station off the line.

3. Telemetering Code

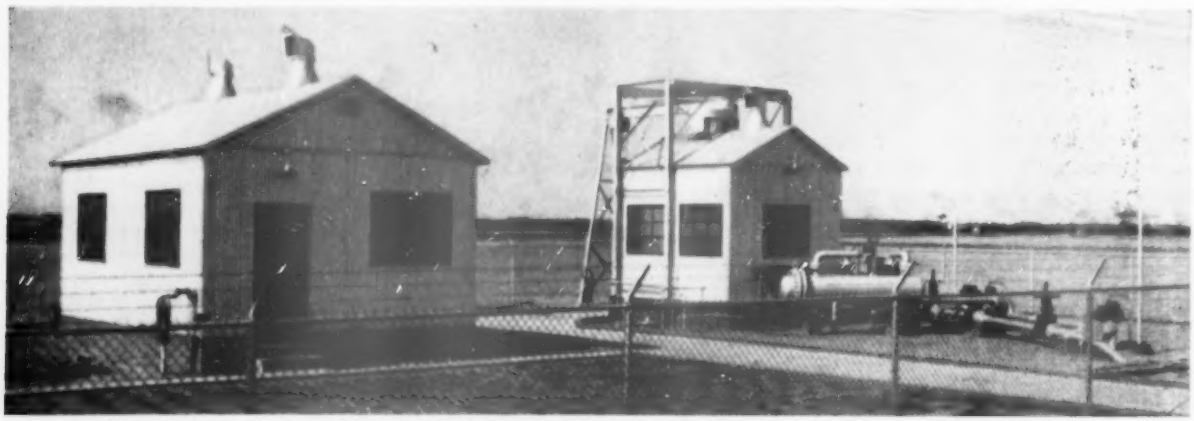
Upon receipt of the telemetering code, the control relay circuit is actuated and connects to the General Electric and Bailey meter equipment. Through a sequence circuit, the A. T. & T.'s equipment samples on a time basis; first checking the suction pressure meter and sends the letter S to correspond to each 10 psi. The next step in the sequence is to sample the discharge pressure, sending D for each 20 psi. The final step is to sample the ammeter in the pump motor circuit and sends the letter A for each 2.5 amp. of motor current.

4. Lockout Alarm Indicator Code

The lockout circuits indicate the condition of the pump-station alarm. The equipment is so arranged that the receipt of a temporary or permanent lockout will open the motor circuit and stop the pump motor, therefore making it impossible to start the motor by dialing until the lockout circuit returns to the "no trouble" position. The circuits are so arranged that in case of a temporary lockout, this lockout will

THE AUTHOR

Louis Nixon Young was associated with the Globe Oil & Refining Co. at McPherson, Kans., from June 1937 until entering military service. His service during World War II was with the Corps of Engineers in pipe-line and terminal work in Europe. On returning to the states, he was reemployed as assistant maintenance superintendent by National Cooperative Refinery Association, which had purchased the refinery in 1942 from Globe. In 1948 he built the N.C.R.A. terminal at Irvington and at the present time holds the position of products pipe-line and terminal superintendent. Young graduated from University of Oklahoma with a degree in mechanical engineering.



AUTOMATIC BOOSTER . . . Control house is at left, the other building is the pump house. Receiver selector at each station responds to four separate codes. Fig. 6.

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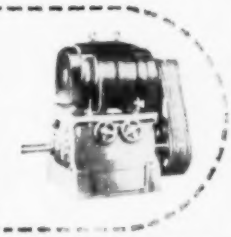

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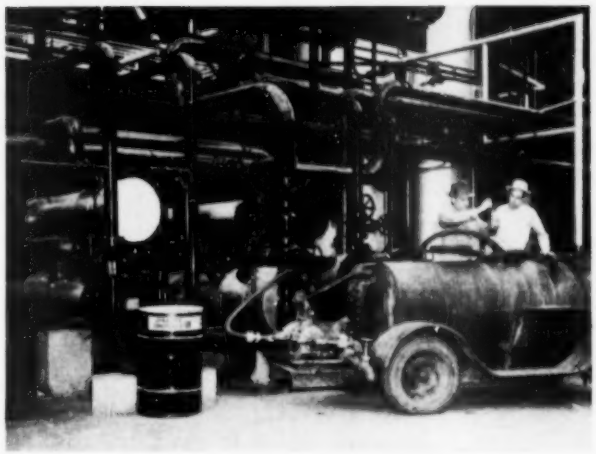

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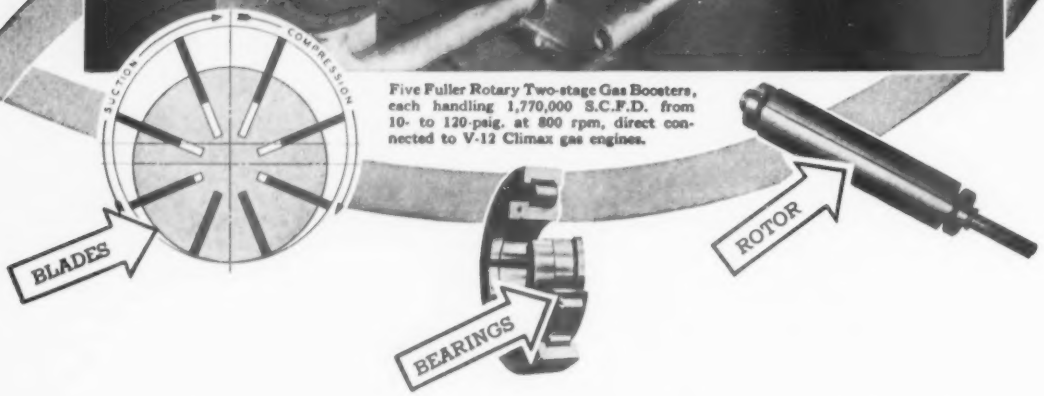

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clear itself, and the pump motors may be started again; however, with a permanent lockout, the station must be inspected and repaired by a mechanic. In case of a temporary or permanent lockout, the suction and discharge valve will close automatically after stopping the pump motor, leaving the station valves in their normal starting position.

Automatic Starting

The electric equipment was designed by General Electric Co. to operate with the teletypewriter. Automatic starting may be initiated either locally, by push button, or remotely by teletype code, depending on the position of the control transfer switch. After receiving the code from the teletype by dialing a six-digit number, the suction valve will start opening. When the suction valve is wide open, the motor starting contactors are closed and reduced voltage is applied to the motor. At the same time the discharge timing relays are closed and the discharge valve starts to open. The timing is such that the motor is up to speed a few seconds before the discharge valve is open.

Protective devices . . . All seven of the following protective devices must be in a normal position before and during starting of any station:

1. Suction and discharge valves must be closed.
2. The system voltage must not dip below a predetermined value.
3. Suction pressure must be above ten pounds before and during starting.
4. Line discharge must be below maximum pressure during the starting.
5. Air to control valve must be above 25 psi. pressure, in order to operate control valve.
6. Liquid from seal to liquid-level control must be normal.
7. Starting sequence must be completed within preset time.

Automatic Shutdown

Automatic shutting down of any station is also done by a code of six numbers, deenergizing the starting contactor and run contactor which removes the pump motor from the line and, at the same time, closing contacts to close the suction and discharge valves.

Pumps and Motors

The 20-stage Byron Jackson vertical centrifugal pump connected to a 300-hp. Louis Allis vertical electric motor was used at Abilene and Tecumseh stations. This combination makes it possible to eliminate expensive building and to group all the pressure controlling equipment. The vertical pump has two advantages over the horizontal split case pumps. First, it makes possible development of maximum pres-

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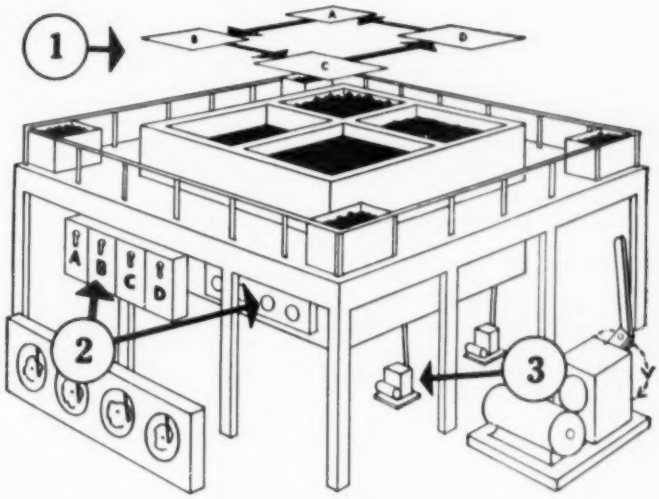

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② **FIRST** plant to employ thermostatic temperature controls, with electric-eye flame controls and recording thermometers, to control the time and record the temperatures while melting the enamels to correct application temperature. These controls were the first used to prevent changes in physical characteristics of the enamels.

③ **FIRST** plant to provide mechanical cradle agitators for each kettle, to prevent sedimentation of enamel fillers added by the enamel manufacturers as a reinforcement for the bitumen.

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sure of 1,200 psi. with one centrifugal pump. Second, operation only with one mechanical seal and the sealing of suction pressure only is made possible.

Pressure-Controlling Equipment

Fisher air-operated control valves with "Positrol" valve positioner was installed at each station to maintain a maximum line discharge pressure of 1,200 psi. and a minimum suction pressure of 50 psi. The operation of this valve is controlled by two Series 4100 UR Fisher Wizard controllers and the starting pressure at each station is 225 psi. During starting the control valve will be wide open and position itself to pressure conditions at the station as the discharge valve opens.

Permanent Protective Equipment

Permanent protective relays were included in the original design of the General Electric Limitamp cubicle such as low voltage relay, overload protection of pump motor, sequence timer, and liquid-level control of seal leakage. Additional space is left for other protective equipment to be installed at a later date.

The above permanent protective relays are connected to a 12-point drop annunciator, making it possible to determine at a glance the cause of any shutdown. In the future it is planned to connect additional permanent relays to include bearing temperature, pump case temperature, and motor-winding temperature.

Temporary Protective Equipment

Temporary protection was accomplished by using mercoids with mercury switches, to shut down stations in case of low suction pressure, high discharge pressure, and low air pressure. When these mercoids shut down any station due to high or low pressure, the station will correct itself as pressures return to the predetermined setting of the mercoids.

Buildings

Since these stations are unattended, it was possible to use Braden metal prefabricated buildings. Two buildings were installed at each location and at the required distance between them for safe operation. The pump buildings are 14 by 12 ft. The control buildings housing the electrical equipment are 16 by 24 ft. With the glass fiber insulation in the walls of the control building, it is possible to heat this building during the winter months with two small fan-operated electric heaters and maintain temperatures above freezing. With the adjustable shutters installed in the pump buildings, it is possible to control the temperature during winter months, if desired.

Southern Union Gas Co.'s unattended gas-purification plant near Wink, Tex., operates entirely by automatic controls. Only labor required, other than maintenance, is 1 hour a day by one man to change charts and take readings.

Automatic Controls Effect Real Economy

An unattended gas-purification plant near Wink, Tex., is enabling Southern Union Gas Co. to recover sour gas for distribution in six West Texas towns served by the company, while holding purification costs to a minimum.

by D. L. Nicol

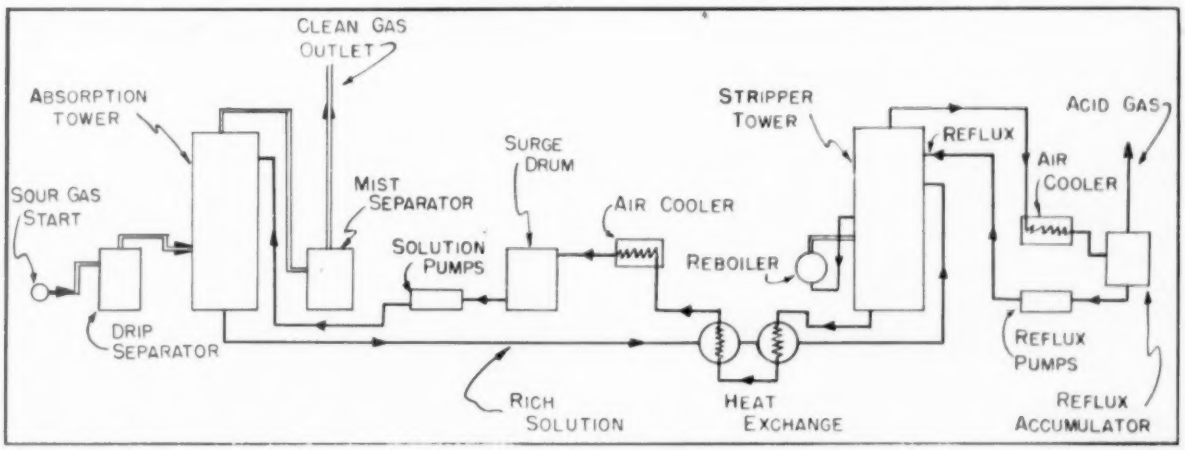
THE Southern Union Gas Co.'s new unattended gas-purification plant is located in an area where the utility company's sales are largely domestic. The towns of Barstow, Monahans, Pecos, Pyote, Wickett, and Wink are served by a connecting transmission system to sweet and sour-gas sources in Ward and Winkler counties. Until the purification plant was placed in operation last March, these towns were supplied chiefly from sweet-gas wells in the area. The unattended plant was designed to extend the supply by utilization of sour gas available in Weiner-Colby field, while holding operating costs in line with the limited throughput available for the plant.

Since labor costs for a supervisor and four shift operators would amount to more than 75 per cent of the cost of operating the plant conventionally, the automatic controls effect a considerable economy. Except for maintenance work done by Southern Union's regular pipe-line crews, the only labor required in operating the plant is 1 hour each day by one man to change charts and take readings.

MEA Absorption Plant

The plant is of conventional design for monoethanolamine solution absorption of hydrogen sulfide and carbon dioxide. The high-pressure system includes the absorption tower and inlet and outlet separators for drip gasoline and solution carryover. Since anticipated growth of the area served by the plant will require higher throughputs in the future, the absorption tower is designed for a maximum capacity of 10 million cubic feet per day at 350 psig. and a sulfur content of 180 grains per 100 cu. ft.

Other components of the plant, used in regeneration of the monoethanolamine solution, include a stripping tow-



Simplified flow sheet of gas-purification plant.

er, reboiler, heat exchangers, reflux accumulator, and surge drum. The stripping tower is designed for a maximum throughput of 30 g.p.m. when the natural gas throughput is 10 million cubic feet per day. However, the reboiler and heat exchangers are designed for a throughput of only 15 g.p.m. Since the present requirement for capacity is only 5 million cubic feet per day, the initial investment was reduced by designing the plant with a parallel system of heat exchangers and installing only half the exchangers required for future full-capacity operation. Parallel connections were provided so that when additional capacity is required, the extra units can be installed with minimum labor and down time.

Direct-Fired Reboiler

The reboiler for the stripping tower was adapted from a standard 45-hp. oil-field, direct-fired fire-tube oil heater. The inlet connection was made to the downcomer on the bottom tray and 10-in. vapor and liquid return line was made to the stripping tower bottom. The only adaptation was to increase the outlet connection on the oil-field heater from a 4-in. to a 10-in.

Since this plant is relatively small and the ground water in the area has a high gypsum content, the use of a direct-fired reboiler reduced the requirement for treated water to only the makeup water in the monoethanolamine solution. To further reduce the water requirements for the plant, the reflux condenser and lean-solution cooler were designed for direct air cooling, using a forced draft and thus eliminating a cooling tower and water well. Water requirements for the entire plant will average less than 400 bbl. of water per year. Steam condensate is trucked to the plant site and stored in a 100-bbl. tank for solution makeup.

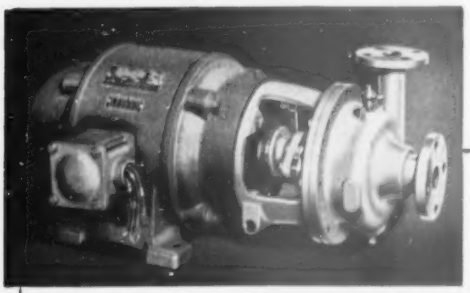
The need for weatherproofing sealing compound on the insulation for the heat exchangers, reboiler, and stripping tower was eliminated by the use of a calcium silicate-type insulation block, covered only with aluminum sheeting.

Since the plant is designed to function without operators, complete instrumentation was necessary to control process variables. Analysis of the process showed that only two variables, solution flow rate to the absorption tower and overhead temperature on the stripping tower, required recording control instruments. Pneumatic instruments with natural gas, instead of air, as the control medium were used. The flow controller operates a motor valve on a bypass between the inlet and outlet of the solution pumps. The temperature controller measures the temperature by expansion bulbs in the tower and transmits pressure to the controller in the pump house, which operates a motor valve on the fuel gas line to the direct-fired reboiler to maintain a fixed temperature at the stripper overhead.

Liquid level controls . . . Other controls, primarily to control liquid flows, were required on each tower and separator, and liquid-level controls were used. These five controls include two dump-valve-action, level controllers on the high-pressure drip gasoline separator and solution-carryover separator.

THE AUTHOR

David L. Nicol, a member of Southern Union Gas Co.'s engineering department since October 1952, was the company's supervisor during construction of the unattended gas purification plant described in this article. Nicol received his bachelor of science degree in chemical engineering from Carnegie Institute of Technology and holds a master of science degree in engineering from University of Michigan. He also attended Northwestern University. Before being employed by Southern Union, Nicol was supervising chemical engineer for the Institute of Gas Technology. He also served as junior engineer for Columbian Carbon Co. and was research chemical engineer for Commercial Solvents Corp.



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Take the headache out of pumping acids — use Ampco Centrifugal Pumps. Made of Ampco aluminum bronzes, they have exceptional resistance to corrosion. And they also resist the damaging effects of cavitational erosion, deformation, and wear.

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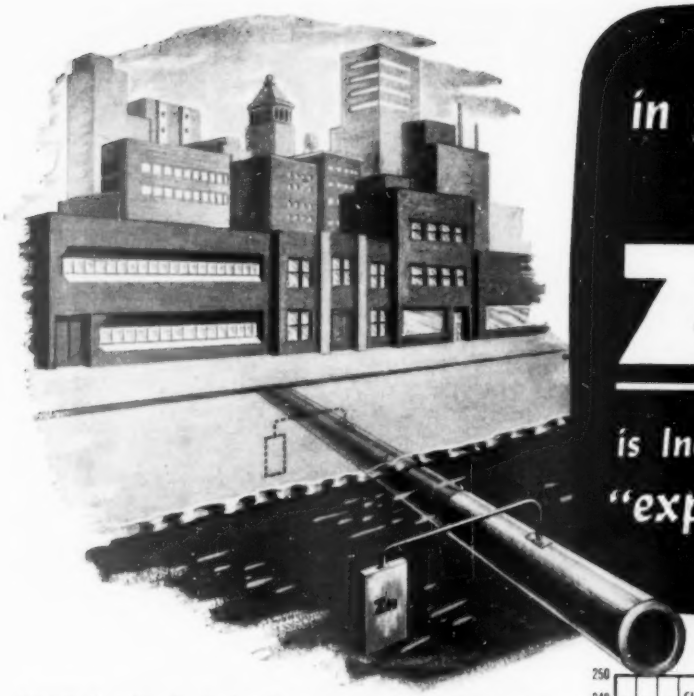


in fighting corrosion with corrosion—

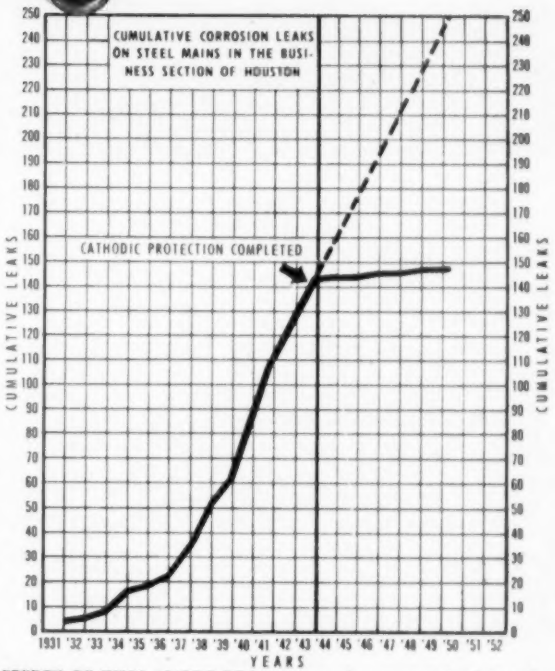
ZINC

is Industry's most effective "expendable" weapon!

NEARLY 50% of all the zinc consumed annually in the United States — around 400,000 tons — is used in galvanizing, i.e., protective zinc coating on iron or steel. This is ample evidence of the metal's firmly established position as industry's most effective and economical "sacrificial" weapon in its unceasing combat with rust. The electrochemical reaction between iron and zinc in galvanizing is precisely the same as that which takes place in the relatively new and growing use of zinc for cathodic protection of pipe lines and other underground iron and steel structures. The sole difference between the two methods being that in cathodic protection the zinc, in the form of anodes, is buried adjacent to a pipe line and connected by a conductor, while in galvanizing the zinc is bonded to iron or steel. In either form, zinc "protects"— as has been attested to by those progressive companies who have used zinc anodes for this purpose. For example in the northwest, a utility company reports:

> *"The most interesting installation was made in 1942 on four inch bare pipe located in the seepage from an irrigation ditch that circled the brow of a hill in such a manner that the pipeline trench intersecting the irrigation ditch was kept moist throughout the season. Approximately seven hundred feet of this four inch line had been replaced twice. In the spring of 1942 leakage developed and when the pipe was uncovered it was found to be in bad condition. Pending replacement, repairs were made and seventeen zinc anodes were installed with series-parallel connections. In the press of other work, this replacement job was put aside and in 1943 it was found that no further leaks had developed. In 1948 the replacement had still not been made and we were getting a good potential-to-ground and plenty of protective current. The last test made in the spring of 1950 shows a slight increase in the potential-to-ground and the pipe has not been replaced nor have we felt it even necessary to uncover it for visual inspection."*

The graph at right provides additional evidence from the State of Texas. Here are two examples, under widely dissimilar conditions, where zinc has proved itself as a highly efficient cathodic protector for underground pipe lines. This is not surprising in view of the long-recognized superiority of the metal in the field of galvanizing.


CUMULATIVE CORROSION LEAKS ON STEEL MAINS IN THE BUSINESS SECTION OF HOUSTON
CATHODIC PROTECTION COMPLETED
CUMULATIVE LEAKS
CUMULATIVE LEAKS
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250
1931 '32 '33 '34 '35 '36 '37 '38 '39 '40 '41 '42 '43 '44 '45 '46 '47 '48 '49 '50 '51 '52
YEARS

EFFECT OF ZINC ANODE PROTECTION ON OLD LINES. *Most of the United Gas Corp.'s welded-steel-gas distribution mains, coated with hot asphalt and asbestos wrapper, were installed before 1930. Cathodic protection of mains with zinc anodes was completed in early 1944. Curve shows cumulative leak record of these mains. Only 5 corrosion leaks occurred in the 6 years since cathodic protection was applied, comparing with 142 during 1932-1944.*

52 PAGES OF NEW DATA

For complete details on this application of zinc, write for free booklet, CATHODIC PROTECTION WITH ZINC ANODES

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The other three liquid-level controls operate motor valves with throttle action to control the solution rate from the absorption tower and the stripping tower, and to control the reflux rate from the reflux accumulator to the top of the stripping tower. Pressure in the regeneration section of the plant is maintained by a back-pressure regulator on the flare gas.

Safety controls . . . The use of control instruments, while eliminating the requirement of labor for operation, does not include the possibility of breakdown of the instruments or process machinery and equipment. Since gas processed through this plant is sold to domestic users, it is particularly important that no gas with more than one-quarter grain of H_2S per hundred cubic feet be sent out in the transmission system. To prevent this, additional safety controls were installed.

These controls were designed for an electrical system with the various controls installed in series on the circuit. Failure indicated by any control breaks the circuit. The four controls used are: (1) a no-flow switch, to stop operation in the event that the solution flow to the absorption tower is interrupted for any reason; (2) a high-temperature switch to stop operation should the fan on the air cooler fail to cool the solution sufficiently to make the solution effective in absorption; (3) a low-temperature switch to stop operation in case the fire in the reboiler fails and temperature is not sufficiently high to regenerate the solution and, (4) a low liquid-level switch which stops operation when the solution is lost from the reboiler and/or the fire tubes are exposed.

In the event of temporary power failure from the high lines, the electric motors which drive the solution pumps stop and deactivate the flow switch.

Switches . . . The no-flow switch uses a tilting mercury switch, which is attached to the pen arm of the flow recorder and opens on low flows. The high and low-temperature switches operate by the differential expansion of two dissimilar metals. The switches are so constructed that the high-temperature switch breaks the circuit when the temperature goes higher than the set temperature and, likewise, the low-temperature switch breaks the circuit when the temperature falls below the set temperature. The low-level switch uses a tilting mercury switch activated by the movement of a magnet attached to a level float. The circuit is broken when the level is lower than the setting of the control.

Shutdown system . . . When failure is detected by any of the safety controls, the plant is shut down by two control valves. The first, a manual-reset solenoid valve, is on the fuel line to the reboiler and shuts the fuel off in the event of failure, indicated by the four safety controls or power failure. The second valve, on the sour-gas line entering the plant, is opened or shut by a gas-activated piston that moves the valve handle. The piston movement is controlled by application of the instrument gas pressure to either side of the piston. A two-way solenoid gas valve controls the instrument gas to the piston. When failure of the equipment is noted in the safety controls, the circuit is broken and the solenoid valve opens to move the gas piston and shut the main-line valve. A check valve on the exit of the plant stops back flow from the outlet main line. The gas load then is picked up by sweet-gas wells riding on the line.

Since being put into operation, the plant has been operated at as low a capacity as 500,000 cu. ft. per day with a solution rate of 10 g.p.m. and at as high capacity as 3,000,000 cu. ft. per day with a solution rate of 15 g.p.m. The high flow rates are not necessary on the basis of chemical absorption capacity, but because of the oversize of the absorption and stripping towers, high flows are required to maintain effective hydrogen sulfide removal.

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Literally, it's here today and gone tomorrow.

Each month we handle approximately 1,500,000 barrels of crude, and all of it, including that we produce, and that fed into the lines by others, is handled through our own system.

The SOMICO emblem itself is always *on the move.* It is appearing in new areas in South Texas, as well as in other regions of the State, as we work with others to find and develop new reserves to the end that our country's economic and defensive strength may continue unquestioned and unchallenged.

If you have a crude oil transporting or marketing problem in South Texas the chances are we can help you whip it. We are always looking for new "connections" . . . for a chance to keep oil *on the move.*

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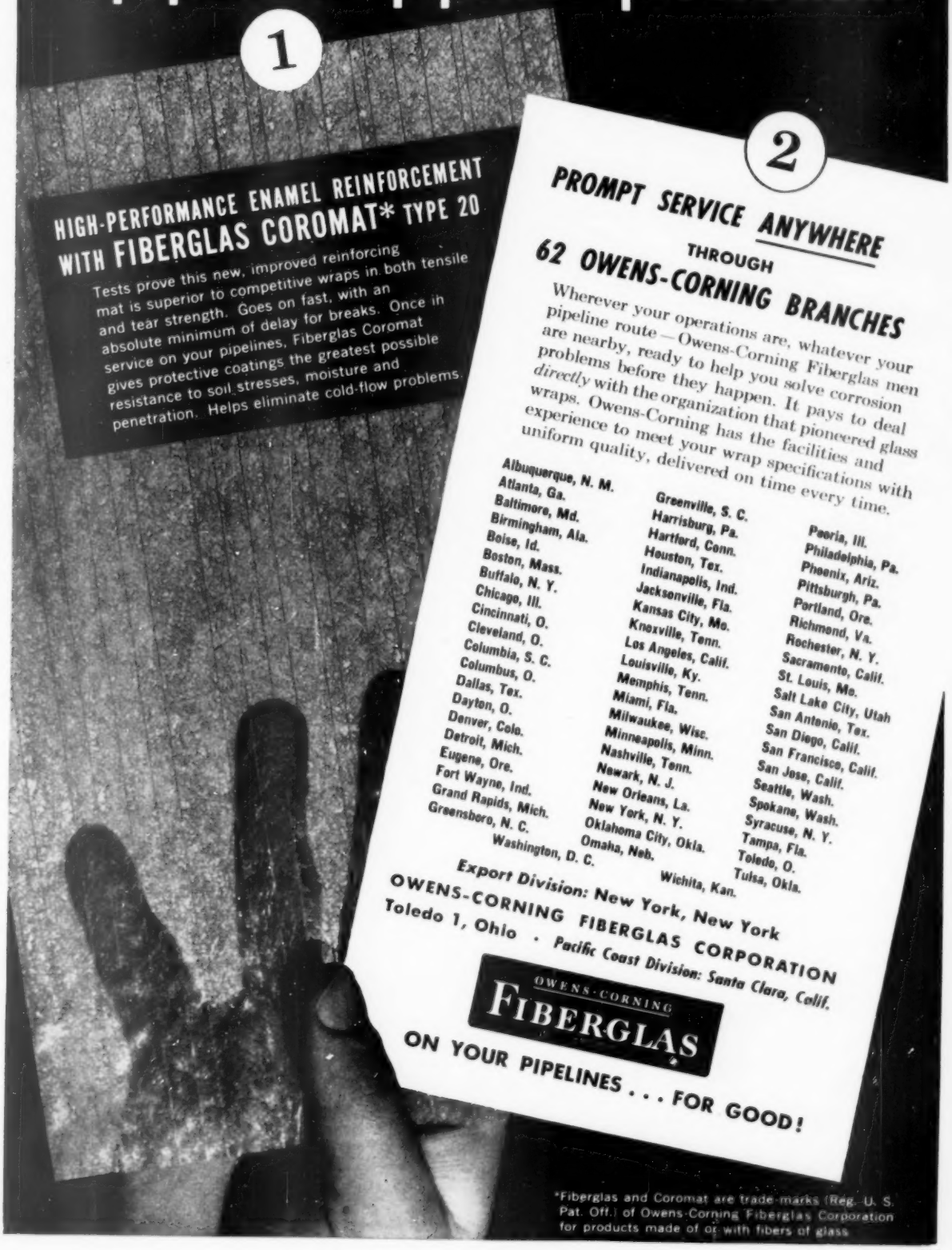

1

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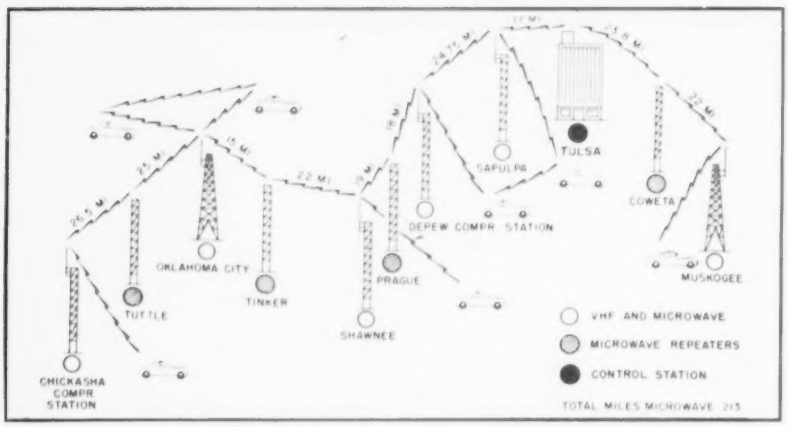
54-I

Fig. 1—Schematic sketch of Oklahoma Natural Gas Co. microwave system.



Sapulpa microwave repeater and V.H.F. system, and parabolic microwave detector.

BETTER COMMUNICATIONS

Oklahoma Natural Testing New Microwave-V.H.F. Radio System

by W. R. Kubista
Chief engineer, Oklahoma Natural Gas Co.

IN connection with Oklahoma Natural Gas Co.'s expansion program designed to provide an extensive, interconnected pipe-line system reaching distant reserves of adequate magnitude, the need for a more extensive communication system became evident. A study of the various means of communications was made, including telephone, private-wire lines, and radio. It was concluded that a combination microwave and V.H.F. radio system would in the long run best meet operating requirements at a reasonable cost. Such a system has been constructed and is now in various stages of test operations.

Although microwave radio communication is not exactly new, it has only recently become popular with gas and oil pipe-line companies. It offers a number of channels equivalent to wire lines, which may be used for voice communications, telemetering, remote control of pumps, valves, etc. Any function that can be converted to an electrical impulse, such as pressure or temperature, can be transmitted by microwaves to recorders located at chosen remote points. Most of the services offered by microwave radio will ultimately be used on the Oklahoma Natural system, a schematic sketch of which appears in Fig. 1.

Microwave-V.H.F. System

The V.H.F. system for radio communication from a fixed station to a car or truck or vice versa operates at a frequency lower than microwave but it will, on the Oklahoma Natural system, operate in conjunction with the microwave.

Microwave terminals . . . These are at Muskogee and at Chickasha compressor station near Chickasha. They are also V.H.F. stations. Other microwave-V.H.F. stations are situated at Sapulpa, which will serve the Tulsa area, Depew compressor station and underground storage, Shawnee, and Oklahoma City. The system is under the general control of the chief dispatcher in Tulsa for the reason that gas-system operations are coordinated through his office by people on duty day and night.

Microwave data . . . The microwave system operates in the 2,000-mc. (megacycle) band and has a capacity of 24 voice channels and a service channel, each of which can be divided into as many as 18 telemetering circuits or similar functions. Of the 25 channels, 9 are currently utilized. One is for radio service personnel and equipment failure signals, three for V.H.F. operation and control, two for party-line telephone between six operating

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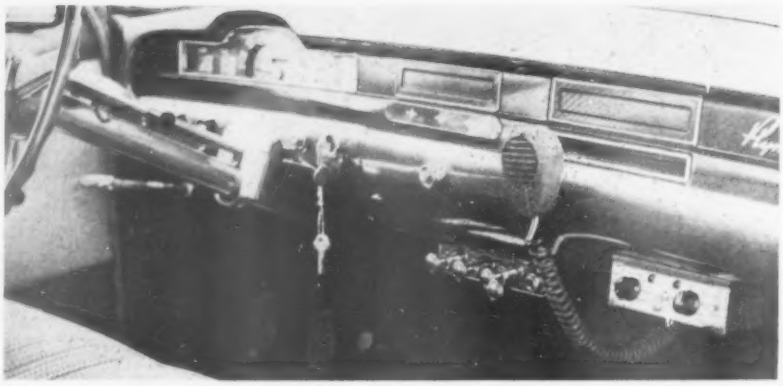
centers, two for private telephone between Tulsa and Oklahoma City, and one for teletype communication between Tulsa and Oklahoma City. The microwave voice channels connect into P.B.X. boards at Muskogee, Tulsa, Shawnee, and Oklahoma.

Mobile units . . . Such units in the cars and trucks are equipped for selective signaling as well as for all call operation. The three microwave channels for V.H.F. operation and control are used as follows:

1. Since all cars and trucks will normally operate on selective signaling, a channel for emergency purposes has been provided through all base stations. This permits the chief dispatcher to take control of the entire V.H.F. system and mobile units in any emergency.



Typical mobile unit.

2. A second channel provides a means of reaching vehicles beyond the reach of the caller's V.H.F. base station or vice versa.

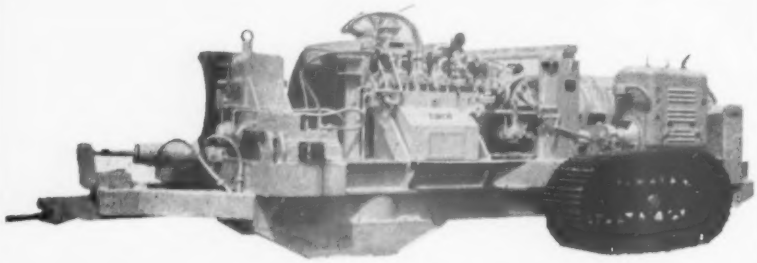
3. The third channel is a short leg between the Sapulpa unattended station and the chief dispatcher's office in Tulsa. It provides a means of remote operation of the Tulsa V.H.F. base station situated near Sapulpa.

The microwave channeling equipment, which makes it possible to transmit numerous types of information simultaneously, is known as the single-sideband multiplex system. Microwave antennas are mesh-type parabolic dishes ranging from 4 to 6 ft. in diameter. Transmitters and receivers are connected to the antennas by means of coaxial gas filled cable. Each station is equipped to indicate in the chief dispatcher's office in Tulsa the failure of its transmitter or receiver, tower lights or power.

Each V.H.F. station is of the conventional type used by public utilities and throughout the oil industry. All are equipped with 60-watt transmitters. The mobile units also have 60-watt transmitters and the receivers are arranged for selective call as well as all call operation.

Buildings at all unattended stations are made of insulating concrete, others are steel buildings insulated throughout.

The system was laid out and tower sites chosen from data which were obtained by means of an aerial survey. This method employs a combination of instruments including radar, altimeter, movies, and a flying technique which furnishes the necessary data to make profile charts of the microwave path. The system was designed and constructed by the Radio Corp. of America.



CINCH BENDER hit the pipe line industry in 1948

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Here's why the Cinch Hydraulic Pipe Bender gives the owner the pipe line he desires—gives the contractor better production methods— Numerous pipe line contractors who now use Cinch Pipe Benders have found that Cinch assures them speedy, economical, safe pipe bending—pipe that is bent smooth—right on the job. Though many methods have been tried in pipe bending, no better way has been found than the cold compression bending under hydraulic pressure—originated by the manufacturers of Cinch Pipe Benders. The powerful Cinch Heavy Duty Pipe Bender processes pipe up to 30" diameter with ½" wall thickness—yield strength to 50,000 PSI—without weakening the pipe. Numerous engineering tests proved conclusively that the bend—when made with a Cinch Bender—is the strongest point in the pipe line.

ADDED FEATURES OF THE NEW MACHINES:

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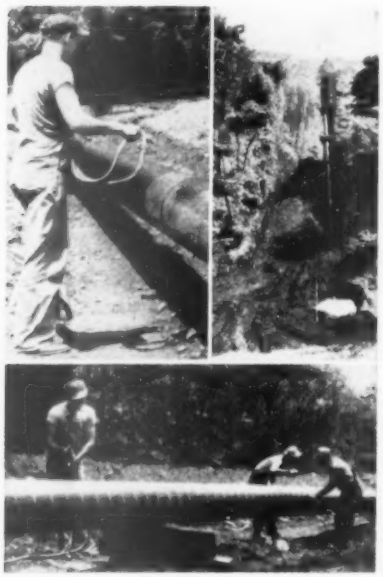

Upper Right—An Equitable Gas System 20" line through rough country. Upper Left—First coat of Roskote being sprayed on this line in the field, no primers needed. Bottom—The pipe is then wrapped with Royston Glas-Wrap and given a second coat of Roskote.

Not just the easy jobs for Roskote! It's tough enough to withstand the abrasion and corrosion of any soil, keeps its flexibility from -40° to 375°F. without brittleness or sag. Utility and pipeline companies know they can forget their corrosion worries when their pipe is "Roskoted". Roskote is applied cold, dries fast to save time and is non-toxic. It resists acids, alkalies and moisture—has an electrical resistivity of 20 megohms per square foot.

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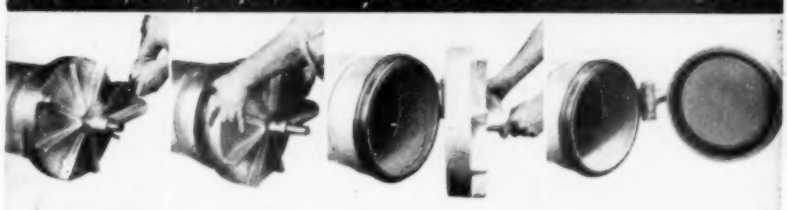
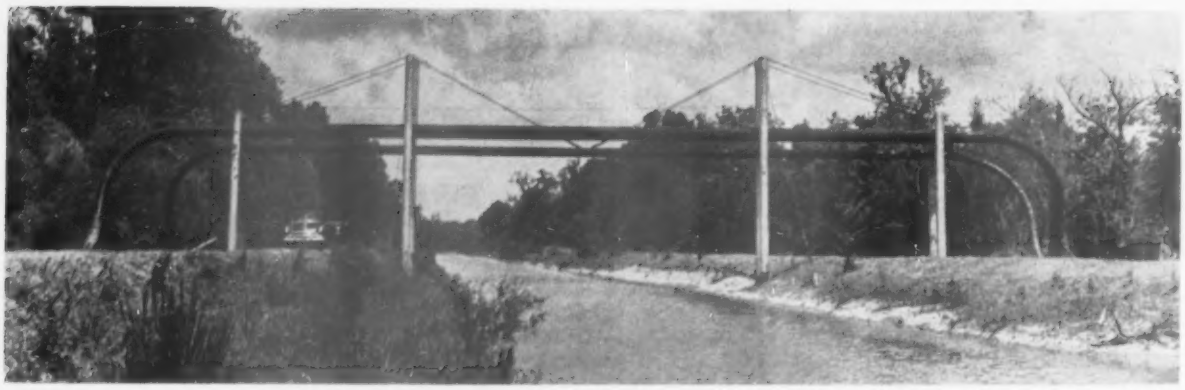




Beaumont Water Canal crossing of new Cities Service crude-oil line. Bridge bents were prefabricated from 10-in. pipe and floated to location.

Numerous Water Crossings Mark Route of Cities Service Sour Lake-Rose Bluff Line

Two rivers, numerous canals, and 12 miles of swamps pose crossing problems

by Harry Nelson*

ON April 24, 1953, Cities Service Pipe Line Co. placed in service its new 20-in. crude-oil line from Sour Lake, Tex., to Rose Bluff (Lake Charles, La.), a distance of 65 miles. This line parallels the original 12-in. line. The project also involved the construction of seven 120,000-bbl. floating-roof tanks and major changes in the station piping at Sour Lake station.

The line crosses the Neches and Sabine rivers, the Beaumont Water Canal, numerous irrigation and drainage canals, and 12 miles of swamps. All pipe was ¼-in. wall, electric weld, except the two river crossings where 5/16-in. wall was used. The river crossings were weighted with a reinforced concrete jacket to provide 20 lb. per foot negative buoyancy in sea water, but no extra weight was used through the swamps. Gamma-ray photographs were used to inspect all welds in the river crossings and about 10 per cent of the welds elsewhere.

*Manager, Cities Service Pipe Line Co., Bartlesville, Okla.

Coating . . . Due to the wet terrain, no ditching machines were used on the entire job. All ditching was done by backhoes and drag lines. Due also to wet terrain, all pipe was yard coated. The coating consisted of primer, 3/32-in. (minimum) enamel, glass-fiber inner wrap, and 15-lb. perforated asbestos felt. The enamel was a relatively new asphalt-base product and was considered superior to the usual coal tars in many respects, particularly as to cold flow. The welds were coated by the use of recent developed cardboard molds filled with hot enamel. Present readings on the cathodic system show about one-half as much current is being used on the new 20-in. as on the original 12-in. line, indicating an excellent coating job.

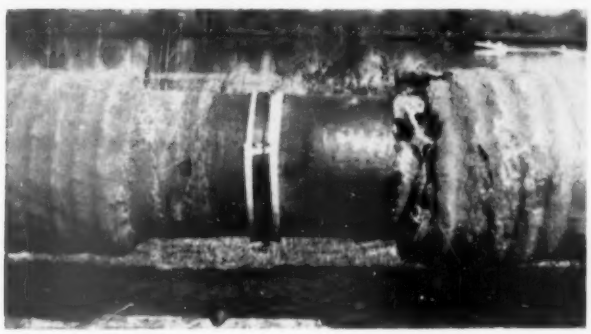
Bridge . . . All major irrigation canal crossings are cased in 24-in. and on overhead A-frames. The approaches were made by using 22½° tube turns. A bridge originally built for the 12-in. line across the Beaumont Water Canal was also used for the 20-in. Four 90° factory bends were used as approaches. This bridge is a unique design. The bridge bents were prefabricated from

Floating pipe through swamp. Much of the route was through this kind of terrain.

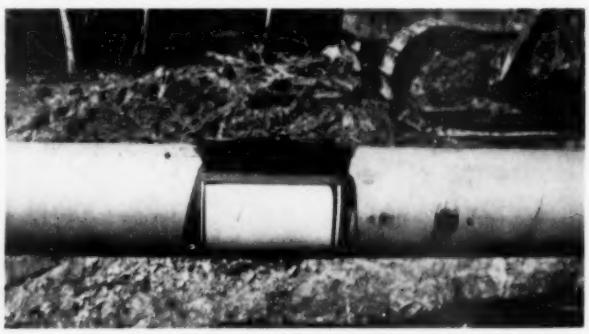
Typical irrigation canal crossing. Both lines in casing. Old line is at right.

Tug holding pipe against current.

Pipe joints on pontoons arriving at locations.



Gamma ray film on weld. Concrete-coated river pipe.



Field jointer envelope for coating welds.

10-in. pipe and floated to the location. It was built during World War II and camouflaged to Navy specifications. The camouflaging is very effective in that it is very difficult to spot it from the air. Because of the abrupt bends at canal crossings, it has been necessary to use a special pig which is in effect two short pigs joined together with a universal joint. This special pig has had no trouble to date traversing the abrupt bends.

Casing insulation . . . An improved-type insulator-spacer was used between the pipe and casing on all road, railway, and canal crossings. The spacer consisted of a wide metal band in two segments bolted together at the sides and fitted with steel lugs for centering. Under the metal band is a layer of corrugated synthetic rubber. The purpose of the corrugations is to prevent squeezing out the enamel. All casings were end sealed by a device using an L-shaped rubber gasket, which was held against the end of the casing by a steel follower, and against the 20-in. pipe by a small wire cable.

River crossings . . . These were prefabricated at the coating yard, including even the bends and concrete jackets, then towed to location. Pontoons provided buoyancy to counteract the added weight of the concrete jacket. The pipe was filled with water upon lowering into place.

Pipe in the swamp areas was placed by the "push" method, which means that all welding is done on high ground and the line floated up the ditch as successive sections were added.

Testing consisted of pumping a sizing scraper through with water, followed by a shut-in water pressure test to 1,000 psi. for a period of 24 hours. No leaks occurred.

Tank protection . . . In order to expedite delivery, the order for the seven new 120,000-bbl. tanks at Sour Lake was split among three suppliers. Consequently, the tank farm now has four different types of floating roofs. So far all types have been satisfactory.

Since the usual aluminum paint jobs on tank roofs have very short life in this humid climate, it was decided to try the new coating developed and used so successfully in Australia. It is sometimes described as an electrochemical galvanizing process. After a very thorough sand blasting, the material is sprayed on and cured with acid. The increased life expectancy should more than justify the added cost.

Some grades of West Texas crude to be handled contain certain aromatics (toluene) which will dissolve all coal-tar coatings. Therefore, protection of the rim plates, the vapor-space areas of the floating roofs, and the tank bottom presented somewhat of a problem. Obviously something other than coal-tar coatings was needed. Therefore, the rim plates and hatches were coated with a thermosetting phenolic coating that has been used very successfully in tank cars carrying formaldehyde.

Magnesium anodes . . . To combat tank-bottom corrosion (interior), 97 special mushroom-shaped magnesium anodes were installed in each tank. Under each anode was placed a pad of coal-tar enamel 4 ft. in diameter in order to disperse the electrical current. The remainder of the tank bottom was left bare. Since some water will always be present, the aromatics mentioned above are not expected to be particularly harmful to these dispersion pads. The life of the anodes is estimated at 12 years by the corrosion engineers.

No exterior coating was used on underneath side of tank bottoms. The same cathodic system used on the original tanks will be expanded to take in the new tanks. It is felt that cathodic protection is less expensive and more positive than coatings.

Pumps . . . Although larger suction lines and two tank-farm booster pumps were required at Sour Lake, no increase in station horsepower has been installed. In order to develop the ultimate capacity of 200,000 bbl. daily, additional horsepower will be necessary. The present capacity is approximately 140,000 bbl. daily with two units in parallel.

The station equipment consists of

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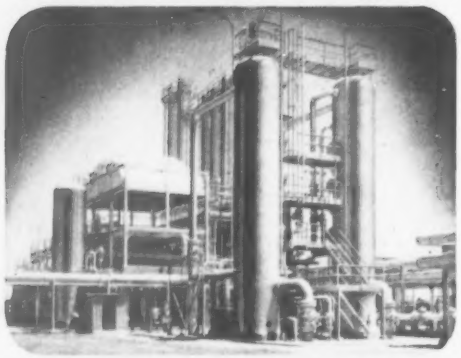
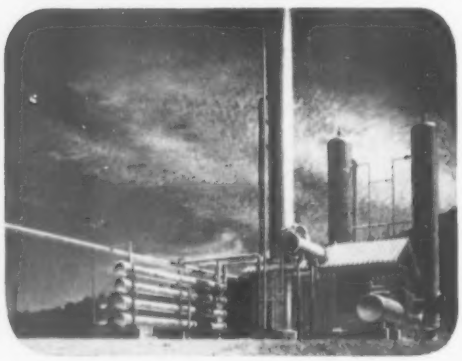


amine-type desulphurization plants . . . . . .



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three centrifugal pumps, one driven by an 800-hp. synchronous motor, and the others by 670-hp. diesel engines through speed-increaser gears. The diesel engines have been converted to natural-gas fuel with pilot injection, resulting in considerable savings in fuel costs and lube oil. Crude oil from the line is used for the ignition fuel. Cooling of engine water, engine lube, and gear lube is by outdoor radiators equipped with forced-draft fans. At present the electric unit is used as standby only. An intermediate station on the original 12-in. line near Orange, Tex., has been shut down and will be salvaged.

Remote gaging . . . The project also included automatic remote reading tank gages to all 22 tanks on the Sour Lake tank farm. Gages can be read either at the tank transmitter or in the pump station on a panel which shows only the desired gage numerals in colored lights. Cables for the automatic gages are attached to the aboveground tank-farm piping. Plug-in voice-powered phones provide communication between tanks and the station for adjusting the gaging equipment.

Special Jet "Trencher"

(Continued from page 175)

30 ft. north of the pipe line and 20 ft. deeper than the pipe, in hope that the material would run into the ditch and cut down the overburden. However, the material was very stiff and did not run once workers left the soupy area near the New Jersey shore. Therefore, a ditch was dug 25 ft. south of the pipe line. But the material stood up almost at a 1-to-1 slope. Ditches were now on both sides of the pipe line, with a center section approximately 30 ft. wide, right over the pipe.

Nature helps . . . It was then that nature stepped in to lend a helping hand. Full-moon tides increased the water velocity, particularly on the ebb tide, and the center section began to slough off. The overburden decreased from 14 to 6 ft. When the dredging program was suspended, 140,000 cu. yd. was removed and hauled out to sea in bottom-dump scows.

Trenching resumed . . . Jet-trenching operations were resumed and progress was much better, with crews making 100 to 200 ft. a day. During the night, silt rolled in on the trencher so that it required 2 to 3 hours each morning to get it free by hand jetting. For this reason, it was then decided to go into continuous 24-hour per day operation, 7 days a week.

On June 17, the first pass with the

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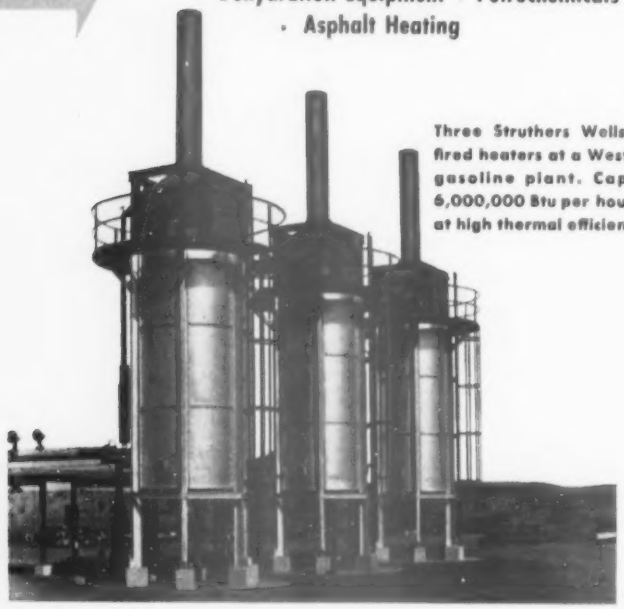

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jet trencher had been completed. Now all the overburden had been removed, and progress was 1,000 ft. each 24 hours. The wooden slats that protected the pipe-line coating during the pulling operation, however, gave continual trouble by fouling up in the rollers of the trencher.

Underwater obstacles, such as pilings, timbers, oil drums, old tires, and wire rope, all had to be removed by the divers. Because of the effect of the tides they were able to work only 30 minutes out of every 6 hours.

One pulling collar, clamped to the pipe, had to be removed by burning it off underwater. The cutting torch used 5/16-in. hollow electrodes through which 90 psi. of oxygen flowed, with 400 amp. on the rod. Eleven complete passes were made and several short ones were required by the trencher.

Probing survey witnessed . . . On July 7, the Army Engineers witnessed the company's probing survey. A 4-in. probe, 66 ft. long, with a half-circle made of 2-in. pipe welded on the bottom, was used in this operation. A 12-ft. bar of 2-in. pipe was welded on top of the probe in the same plane as the half-circle, so that when the half-circle was over the top of the pipe, the bar above the water could not rotate the probe; then the probe was thus centered on the pipe. This probe was handled by a ¾-yd. crane on a 30 by 90-ft. barge.

Weighting . . . After the Army Engineers had accepted the results of the probing survey, installation of the anchor weights began. These weights had been designed to latch onto the pipe; however, due to the side walls of the trench being vertical for the most part, it was decided to latch only every other weight. The 2-in. latching bar will be noted in the photograph of the roller weight. The black bands on the rollers are a polyvinyl tape, three layers thick, to avoid metal-to-metal contact between the pipe and the weights. These were installed at the request of O. W. Wade, Transco's cathodic-protection engineer.

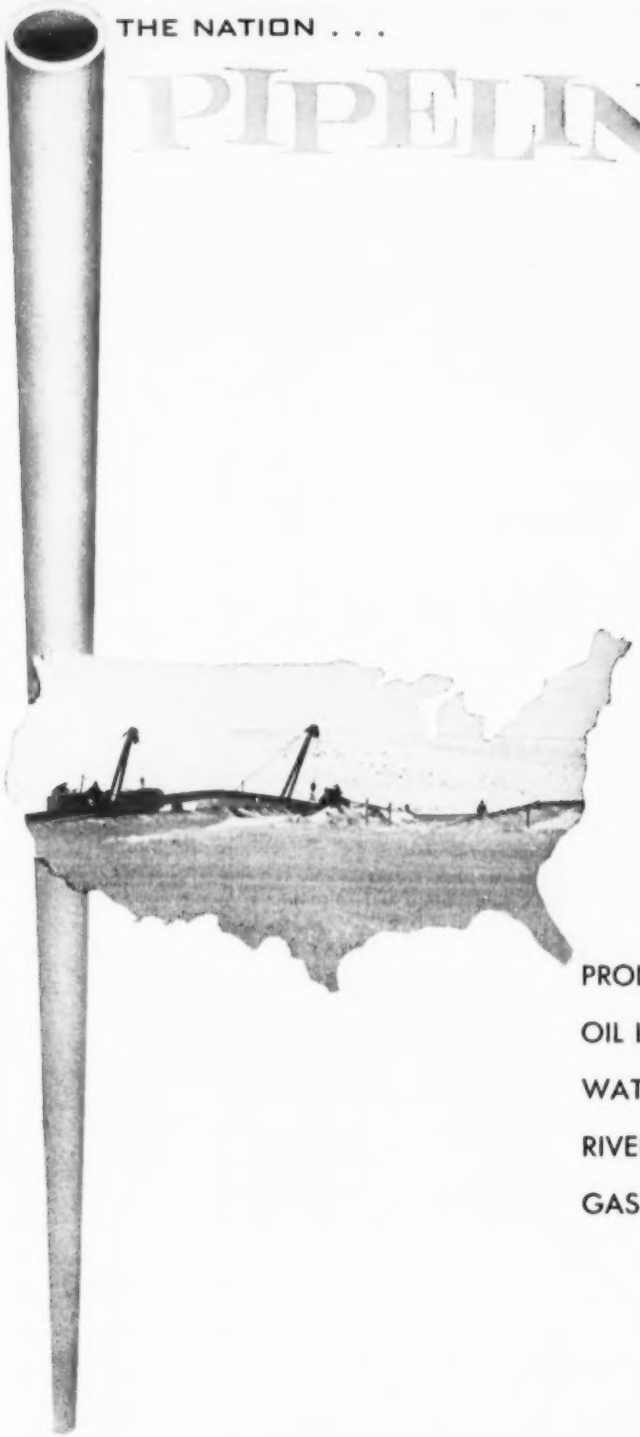
Weights were lowered over the line and the latch closed by a diver. Every 24 hours, 17 to 18 weights were installed, or 6 weights at each slack tide.

Roller weights were installed every 30 ft. and weigned approximately 1,930 lb. In 90-lb. per cubic foot silt, this added 64 lb. negative buoyancy to the line, with the net result being a 7-lb. per lineal foot negative buoyancy.

The pipe line is being allowed to backfill by natural silting. A patrol boat is maintained on a 24-hour basis to warn ships not to anchor in the pipeline area.

ACROSS THE NATION . . .

PIPELINES



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Mackinac Straits Crossing Is 1953's Most Challenging

(Continued from page 171)

bottom, material at the bottom, and the profiles of the routes of the lines. The greatest depth of water was found to be 240 ft.

Currents at the bottom run only at ½ m.p.h. even when surface currents are at a rate of as much as 3 m.p.h. The direction of currents is affected by winds.

Bottom Material and Trenching

Grab-bucket samples taken at 135-ft. depth indicated that the straits bottom was made up of stiff clay mixed with sand and gravel.

For a distance of 800 ft. from each shore rock drilling and blasting for samples showed that practically the whole area to be excavated is sandy. At the deepest part, the bottom consists of plastic clay with boulders imbedded in the clay. These data were important for planning the main operations and the proper digging range in relation to the center line control. Accurate means for determining distance from the shore were needed because of variations in the depth of the trench.

After the trench had been dug with a width of 12 to 40 ft. at the bottom and the humps in the center had been graded so that the pipe would not be overstressed, and a consistent bearing for the pipe had been established, launching operations started for pulling the pipe.

To depths of 65 ft. on each side, it was required that the pipe be buried. Beyond that depth the lines lie on the natural bottom except at a few high humps which would be cut through in order to eliminate excessive stress.

All pipe in water up to 50-ft. depth is laid in a ditch with no less than 15 ft. cover and maximum cover of 17 ft. The cover tapers off to 0 ft. at approximately 65 ft. depth. Where the bottom is hard rock the ditch may be of lesser depth but would be deep enough to protect the pipe line against ice or anchor damage.

Dredging Operations and Equipment

For each line the trenching on the north side extends 5,000 ft. and on the south side 3,700 ft. Total amount excavated for trenching is 550,000 yd. Dredging for each line, 6 weeks.

Dredging equipment of Merritt, Chapman & Scott at the project consists of three derrick barges with clam shells, two dipper dredges, one with 9-yd. and the other with a 12-yd. bucket capacity (the largest dredge on the Great Lakes), and one 26-in. hydraulic dredge. Together these have combined capacity of 35,000 yd. per day. On the north side, a derrick-type dredge dipper dug a flotation channel for a dump scow and dipper dredge following behind.

In addition to the dredging equipment, the company has three large tugs of 650 hp. or more, two small tugs of 150 hp., and three diesel crew-changing boats. The contractor also has a drill boat for simultaneously drilling three shot holes. There are 260 men engaged altogether for the entire job at the Mackinac Straits crossing.

Equipment Nomenclature

Before discussing the details of pulling equipment and operation, three terms should be defined as they are applied on this project:

1. "Pontoons" are the cylinders strapped to the pipe to reduce negative buoyancy.

2. Two types of cylinders attached to the pulling cable are referred to as "mandrels." One type, attached at 2,500-ft. intervals, has positive buoyancy to reduce negative buoyancy of the cable so as to overcome the tendency of the cable to bury itself. The other mandrel just ahead of the pipe has negative buoyancy to aid in plowing a path at the forward end.

3. The term buoy is only applied to

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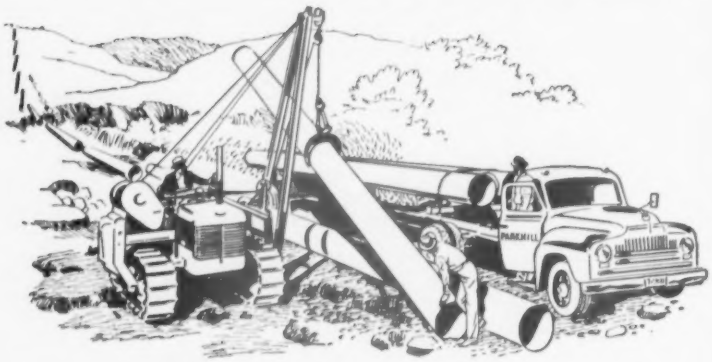

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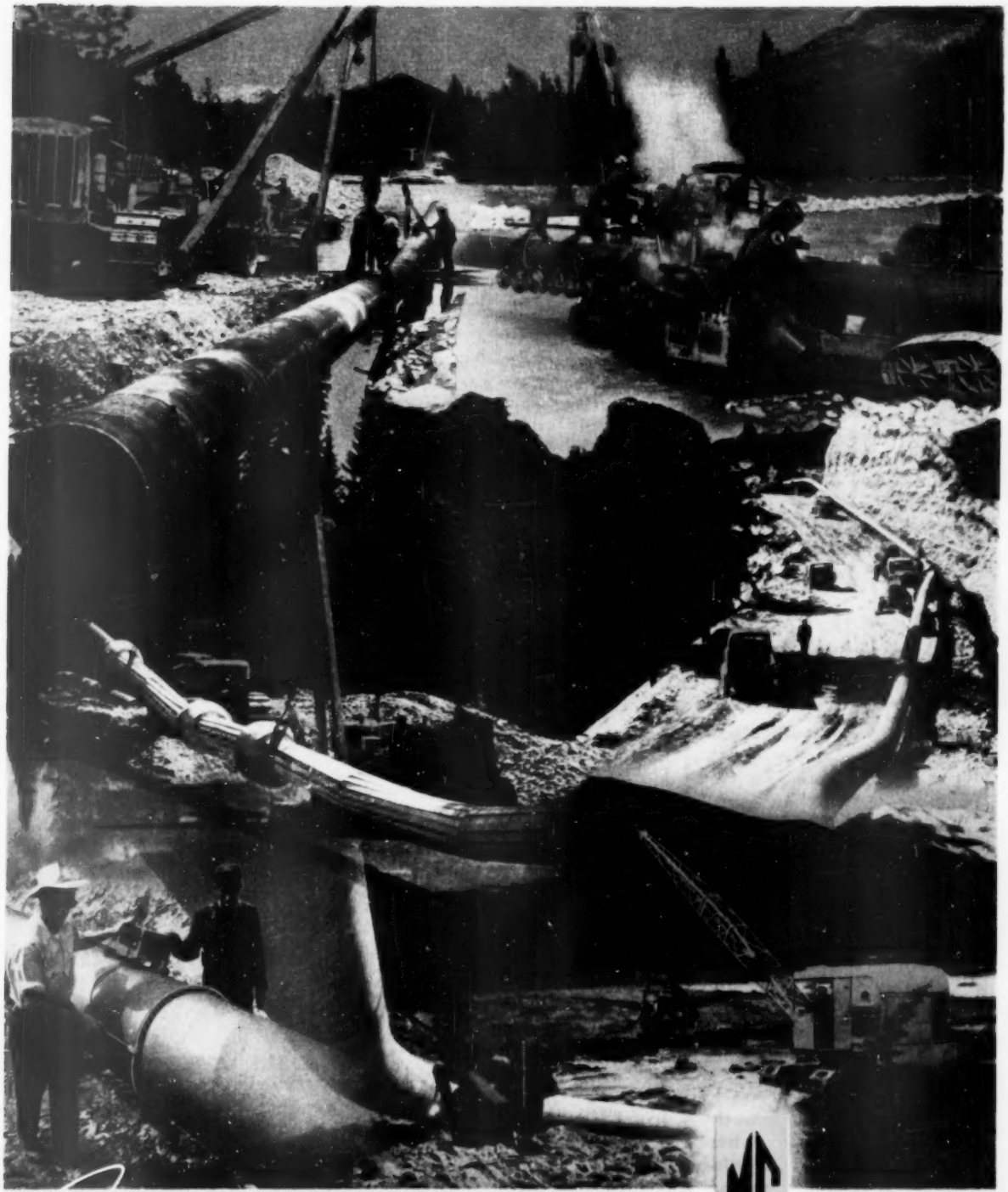

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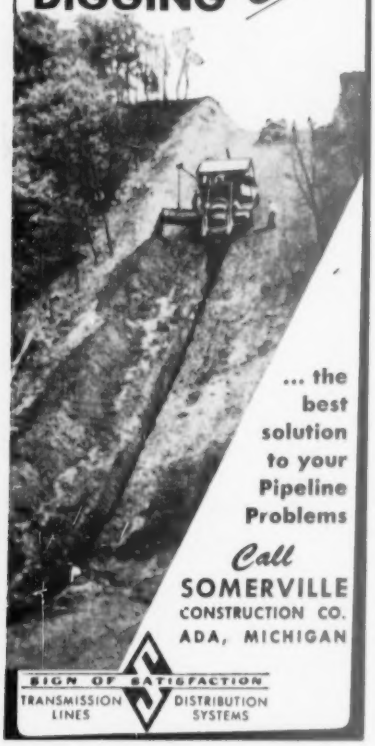

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equipment intended either to float to the surface to carry the end of a pontoon releasing line, or to float on the surface as markers along the side of the proposed route of each of the underwater pipe lines.

4. Connecting (or cargo) plates are triangular pieces of steel which are placed in the pulling line at intervals. These plates have three holes. Two of these are for hooking to the pulling cable. The third hole provides a convenient means for hooking an emergency line when desirable to pull upward from a barge winch.

Cable Equipment and Operation

The biggest problem was to keep the cable ahead of the pipe from burying itself in the bottom of the straits.

The 2-in. cable for pulling the pipe from one shore to the other was made of 2,500-ft. lengths with a swivel every 5,000 ft. At every 2,500-ft. section there was a mandrel with positive buoyancy of 900 lb. to prevent the connecting plates and swivels from getting buried in the mud. The connecting plates are triangular pieces of steel perforated with three holes on which a cable would be hooked when required to avoid losing tension in the pipe.

The mandrel is essentially a connecting pontoon made of 36-in. pipe with ⅜-in. wall, 12½ ft. long with eliptical heads at each end. Through the mandrel there is a 2½ by 10-in. plate with connecting holes on each end. The purpose of the plates is to provide additional means for taking tension on a connecting line from winch equipment operated by two 50-ton line-pull engines mounted on the stern of a 100-ton derrick barge. The pull was straight. Constant tension was kept on the cable to insure it being pulled straight.

Weight of the cable in the water with buoyant mandrels was 5 to 6 lb. per foot. The 20-in. pipe with ½-in. wall, weighing 166 lb. per lineal foot with coating and slats, had a negative buoyancy of 32 lb. per foot; the effect of the attached pontoons is to give the pipe a negative buoyancy of 5 to 6 lb. per foot.

After the cable had been completely laid in the bottom, a test was conducted for pulling without the pipe to insure that the cable was straight and could be moved. After satisfactory completion of the test, the cable was hooked to the first 2,500-ft. section of 20-in. pipe.

Tension

To maintain tension on the pipe line at all times so as to have complete control of the position of the pipe, the pipe was held at the rear on the north shore by two provisions:

1. A 1⅜-in. cable running from a becket anchor through a sheave on the north end of the pipe was held by a winch operated by a 165-lb. steam engine with a maximum rating of 100,000 lb.

2. During tiein welding operations, the submerged pipe was temporarily held by snubbing equipment at the shore.

Tension on the pipe line and the cables was observed at three dynamometers placed as follows:

1. At the 50-ton steam holdback winch on the north shore which will indicate the line pull.

2. At the standing holdback snubbing station.

3. At the 50-ton steam engine-operated winch for the pulling line on the south shore.

Pontoons

Each of the 210 pontoons attached to the pipe at 66-ft. intervals contained 100 lb. of air and had 1,770 lb. of buoyancy.

Equipment to provide for releasing the pontoons was installed on the pipe before launching. These pontoons are fastened to the pipe by tight steel bands.

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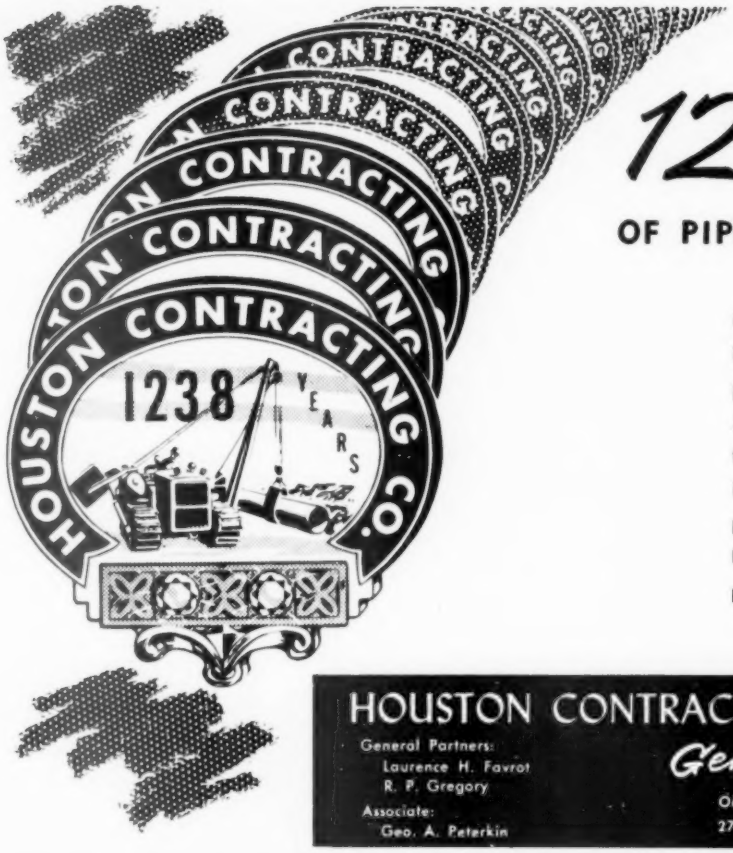

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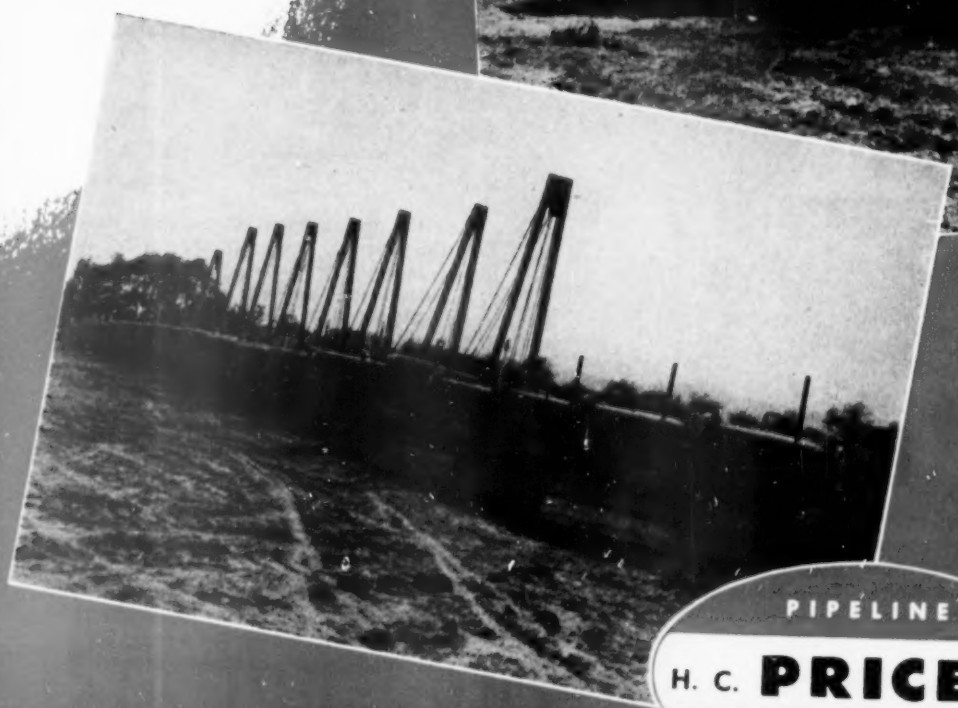

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each large pontoon is released by a tripping action accomplished by having a boat at the surface underrun a ½-in. cable extending the whole length of the pipe. On being released, the small buoy floats to the surface carrying the end of a 1-in. rope that is connected to the releasing mechanisms on the big pontoons.

By means of guillotine releasing mechanisms actuated by pulling the buoyed rope at the surface of the water, the steel bands are cut after the pontoons have served their purpose. The pontoons then pop to the surface and are retrieved.

Pulling

The leading section of pipe was connected by 20-ft. length of cable and a swivel to the pulling mandrel 30-in. diameter by 15 ft. long which acted as a pilot for gouging out a trough for the pipe following behind. Two pontoons each with a buoyancy of 840 lb. were placed on the nose of the pipe to give it zero buoyancy.

After the line had been pulled across, a 4-in. pipe was inserted into the open end of the 20-in. line at the north shore for a distance of approximately 6,000 ft. Water was pumped through this 4-in. line to fill the 20-in. from the deep portion toward each end. This procedure allowed the weighted 20-in. line to settle into conformity with the bottom in connection with the pulling of slack from the free ends on shore.

After filling, a hydrostatic test of 1,200 psi. was applied. After testing, all pontoons were released and the portion of the pipe line and manifold on shore were completed.

Control of Pulling

All operations were controlled from the control tower in the midst of launching operations on the north shore. Here telephone instructions were given to the holdback engine, and the standing-hold snubbing station on the north shore and the pulling engine on the south shore. Directions were also radioed. With the control engineer were three other engineers in the control tower to maintain logs of such data as pipe distances, tension on the wire cables, and speeds of the pipe movements.

The two surveying platforms were installed in water of 75-ft. depth. All distances were carefully measured. Height of water was automatically recorded by recording water gage. Sonic soundings were recorded by three fathometers.

During launching, the pipe was supported on rubber-tired dollies. At the water's edge two pivoted teetering stabilizers, one on land and the other on pontoons, provided additional safe-

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guards against danger from plunging of the line which might have resulted in buckling the pipe.

Pipe and Welding Specifications

Pipe for the crossing was made to special specifications to provide sufficient ductility. It is 20-in. o.d. seamless with 0.812-in. wall thickness.

CHEMICAL COMPOSITION

	composition
Carbon, per cent	0.22 to 0.24
Manganese, per cent	0.30 to 0.90
Phosphorus, per cent (max.)	0.45
Sulfur, per cent	0.06

PHYSICAL PROPERTIES

Yield strength, psi. (min.)	30,000
Tensile, psi. (min.)	48,000
Elongation in 2 in., per cent	35
Pipe lengths (27-ft. avg.), ft.	19-32
Bevels (1/16-in. shoulder), degrees	37½

Most of the welding was done in position with an average of eight beads applied with Class E. 6010 electrode. All beads were run with 5/32-in. rods.

The welding procedure was determined after extensive tests with this type of pipe. As a result, the first two beads were run down hand from top to bottom by two welders working simultaneously on each side. After the second pass was welded, all the welding needed to fill the joint was made uphill. "Weave" beads are used on the uphill welds, not wider than three or four times the diameter of the welding rod. All of the welds for the Straits project were radiographed.

Pipe Protection

Pipe protection is given by 3/32-in. coating of coal-tar enamel, reinforced with glass mat, and covered with a heavy outer wrap of glass fiber, 0.35 in. thick weighing 12 lb. per 100 sq. ft. Whitewash was applied before an outside protection of 1 by 4-in. wooden slats on the bottom third of pipe circumference.

Management

Lakehead Pipe Line Co., Inc., is headed by T. S. Johnston, president of Interprovincial and Lakehead, Toronto, Ont. The affairs of the Superior-Sarnia project are supervised by a coordinating committee.

R. E. Trammell, general manager of Interprovincial and Lakehead, is chairman of the committee. Other members are F. J. Stubbs, assistant general manager, and Roger Clute, chief engineer, both of Interprovincial and Lakehead.

R. L. Hamilton, pipe-line consultant, Van W. Rosendahl, senior vice president, and Clark Rankin, project manager, all with Bechtel Corp.

Merritt Chapman & Scott Corp. operations at Mackinac Straits are supervised by Sherman H. Serre, area manager, and Joseph S. Troxell, project manager for the firm. V. R. Stirling, Tom Geiger, and John Long represent Bechtel at the Straits.

Collins Construction Co. has an office at the Straits and is represented by Samuel Collins and F. T. Glasscock.

Midwestern Constructors, Inc., operations are directed by F. E. Stanley, Clark C. Bledsoe, and M. T. Wilhite, and supervised by Austin Boyd.

Gas-Transmission Lines Across Rivers

(Continued from page 173)

weights. Mats of wood slats protected the bituminous enamel coatings from construction damage.

The Trinity, White, and Illinois rivers have large water sheds and are subject to extended periods of flooding which justified the multiple line crossings. The lines are laid with a minimum cover of 10 ft. except where rock was encountered. This insures against pipe being exposed by temporary scours during floods in the channels of streams

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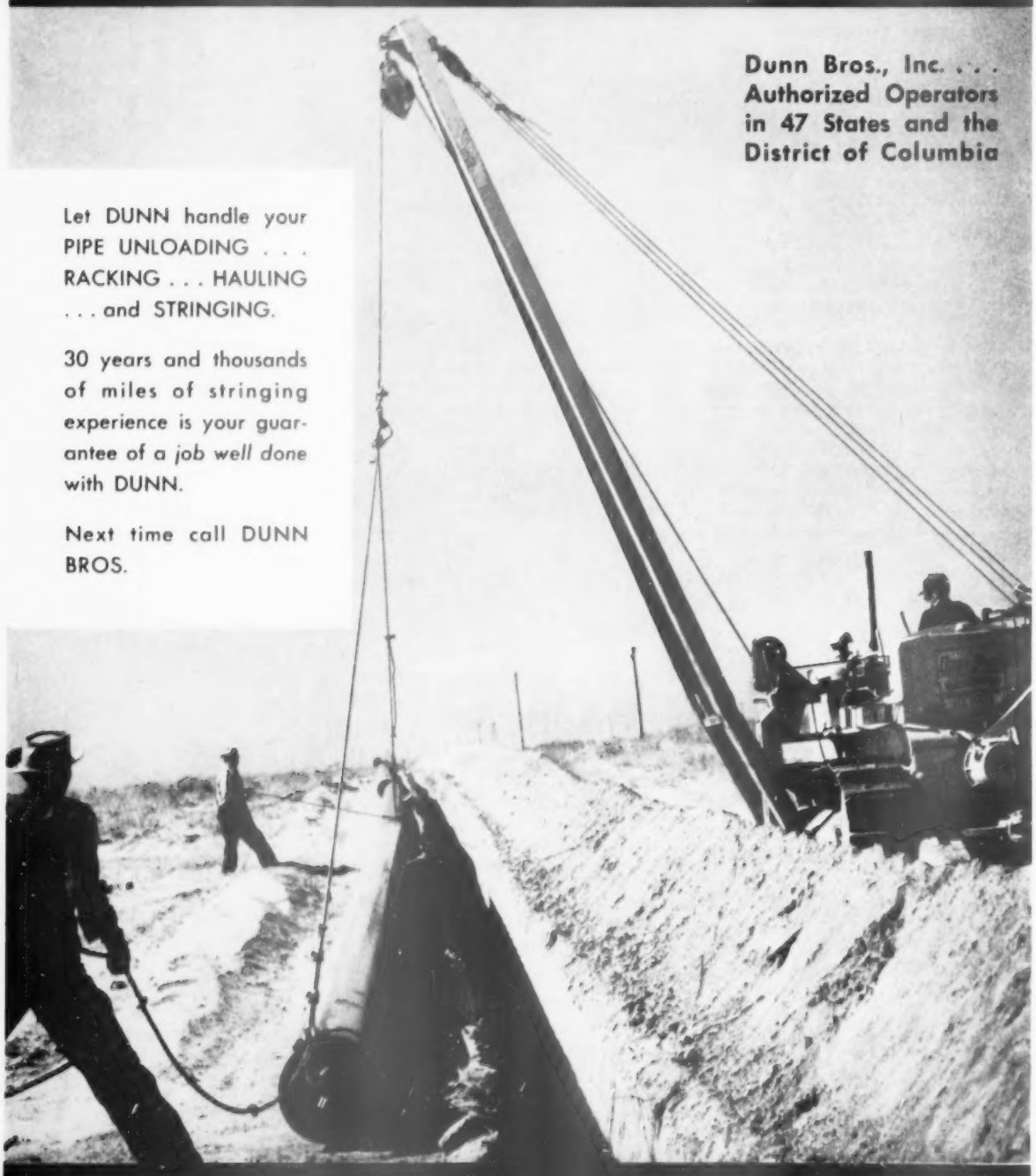

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which would be classed as reasonably stable. The lines were submerged by excavation or dredging and the sag bends were located well beyond the bank line. No serious erosion problems are anticipated.

Arkansas River

The Arkansas River is a stream with an enormous watershed above the crossing. It flows approximately 1,400 miles and together with its tributaries comprises 12.8 per cent of the entire Mississippi River watershed.

It was, therefore, given careful study during the design period. Geological information on the bed of the river and hydrographic data secured from various sources permitted the anticipation of the possible changes which might take place in the stream bed and banks during the life of the crossing.

Thalweg profiles of the stream bed, taken by the Corps of Engineers, U. S. Army, over several decades show the lowest points of scour following floods. They were the basis for determining the depths at which the pipes were to be laid. It is evident from these data that this river has a tendency to scour holes of unpredictable extent and at unpredictable locations. The history of this river records that it shifted 500 ft. southward 65 years ago, then shifted 800 ft. northward over the next 31 years. It progressively widened over the next 13 years. This was followed by a 150-foot swing to the north over a 10-year period. The last shift was 1,100 ft. to the south.

Changing course . . . In applying this accumulation of historical material to the design, the lines were laid 500 ft. apart. The depth at which they were laid was based on a possibility that the bed could undulate as much as 10 ft. below the mean thalweg taken over a period of years. The sag bends on the west side were located approximately 1,000 ft. beyond the normal channel at the time of construction and those on the east side 2,700 ft. beyond the channel. The bank approaches were excavated to a depth sufficient to lay the lines level from sag bend to sag bend. This required the removal of a tremendous yardage of bank material. However, placing the sags safely beyond all known locations of the banks insured against a possible bank failure such as is characteristic of this area where trouble has been encountered by other pipe lines across this river.

Pulled Into Position

After welding the pipe into a continuous length and applying the coating, it was pulled into position across the stream. Preliminary dredging of the channel had opened a pilot trench and further dredging lowered the lines to the desired grade. Elevations taken on the lines in place showed one to be 12 ft. and the other to be 15 ft. below the lowest channel depth at the time of construction.

Obviously there is a crushing force exerted on any buried pipe line. The magnitude of this force is influenced by the fluidity of the backfill material and the depth of burial. In that the pipe diameter was rather large (24 in.), with 50 ft. as the maximum overburden over the line and the river-bed material contained an appreciable amount of wet sand and silt influencing fluidity, calculations were made to determine resistance of the empty pipe against crushing. The heavy-wall pipe gave a large safety factor for these stresses.

Mississippi Bridge

The original plans for the Texas Illinois project called for spanning the Mississippi River with a bridge crossing. The Korean situation prevented the delivery of the necessary materials. The bridge construction was deferred and an underwater crossing was substituted. Work is now being resumed on the bridge crossing to give an assured gas supply across the Mississippi regardless of flood conditions or other hazards which might disrupt the submerged crossing.

Submerged crossing . . . The submerged crossing consisted of three 20-in. lines laid 50 ft. apart under the channel of the river. The pipe was multiwrap with a 15/16-in. wall thickness. The weight of the pipe was sufficient to overcome buoyancy. The total distance between headers is 4,400 ft. of which approximately 2,000 ft. is in the channel of the river.

The crossing is located on the upstream side of a rock shelf in the river channel. This gives considerable protection against excessive scouring or disturbance of the channel material.

Stream-bed data furnished by the Corps of Engineers, U. S. Army, showed that there was no appreciable change in the stream bed over the past 15 years. Prior data was not available. From this information it was felt that a minimum cover of 12 ft. on the lines would insure a stable crossing.

The dredging job was of enormous magnitude and, therefore, equipment was selected which could handle an immense volume of material. A wide sweep to accommodate all the lines was made across the river initially.

Laying operations . . . The pipes were welded into three sections, each approx-

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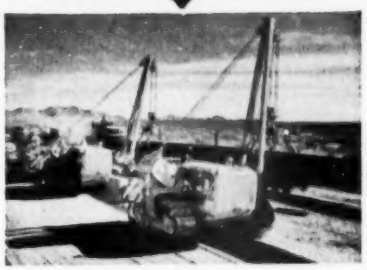

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imately 1,000 ft. long and joined into a continuous length by means of tie-in welds at the bank line during the progress of pulling them into the channel. Protective wood mats were also used on this crossing.

The dredging, made quite difficult by the continuous high water, was continued until the lines were in place. Silt and sand continuously were deposited in the dredged trenches.

The flood waters also hampered the installation of the pipes and, as a result, two of the lines were in a strain at the sag bends. This caused them to fracture during the construction period. Replacement was required. Following this trouble, excessive care was taken that the lines were placed in the trenches without strains imposed by shifting backfill.

Electric depth recorder . . . A year after completion of the crossing, a survey of the stream bed was made using an electric depth recorder at and in the near vicinity of the crossing. In checking these results with the data on the bed of the river during the construction period showed that no appreciable change had taken place. It is realized that a constant checking of the bottom and banks is necessary on a large river such as the Mississippi in order that there will be warning of a change so that in case of trouble, measures can be taken in time to prevent a disruption of the service.

Intermediate Rivers

Four stream crossings, namely the Sulphur, Ouachita, Black, and St. Francis are classified as intermediate rivers. These and numerous minor streams are crossed by a 30-in. single-line crossing utilizing heavy multiwrap pipe between the sag bends.

The single-line crossing was specified for those streams whose beds were reasonably stable so that the possibilities were slight that the pipes would be called upon to withstand any stresses except those imposed by the internal pressure of gas.

Wall thickness . . . The pipe for the single-line stream crossing was made up of ½-in. pipe wrapped with two layers of 5/16-in. The resulting 1⅛-in. wall thickness was of sufficient weight to overcome buoyancy without the use of supplemental weights or anchors. The added strength of the multiwrap pipe wall gave an added factor of insurance for uninterrupted service.

The lines were laid at a safe distance below the gradient of the streams. The survey data of the completed crossings showed an average stream cover of 8 ft. Sag bends were located at

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a safe distance beyond possible bank disturbances.

Trenching . . . In the laying of large-diameter pipe in stream beds where it is necessary to do the work below water, it is highly important to provide a firm, uniform bed to support the pipes so that they do not shift and subject the pipe to unknown stresses. The handling of backfill so that no undue forces are imposed as a result of shifting the lines must also be stressed.

Banks . . . On the banks of underwater crossings, many aids were used under special circumstances to minimize future maintenance. Lines were built to conform to levees by the use of bends eliminating the need to disturb the levee. Backfill materials were compacted in some cases. Revetments, jetties, or rip-rap protected new backfill.

Suspension-bride crossings were used on the Colorado, Brazos, and Red rivers.

The Colorado and Brazos have fairly stable channels, but have high steep banks which can become a problem in the maintenance of an underwater crossing. Both streams were well adapted to the aerial crossing. The bridges were constructed with two main piers near the banks and anchors for their support. A single 26-in. pipe line crosses the Colorado and a 30-in. crosses the Brazos.

Red River Bridge

The bed of the Red River has proven to be so treacherous for submerged pipe lines in the general area crossed by Texas Illinois that the overhead crossing was also chosen for this stream.

It has a fairly well-defined channel at the point of the crossing and an extensive flood plain. Due to its width, it was necessary to design the bridge with the main piers in the flood plain and with adequate foundations to withstand flood conditions. Rest piers support the pipe in the flood plain beyond the main piers.

The span between the main piers is 1,400 ft. with an additional 560 ft. on either side to the rest piers. The pipe is suspended for this total distance. Two 30-in. pipes were laid on the bridge to provide for possible future expansion.

The aim in constructing stream crossing of the Texas Illinois system was to keep the pipe structure out of reach of the destructive forces of nature. At present, the pipe lines have withstood the ravages of two seasons of flood waters. There is no evidence to indicate that they have suffered any impairment whatsoever. However, the measure of success in this accomplishment can only be judged by years of successful operation.

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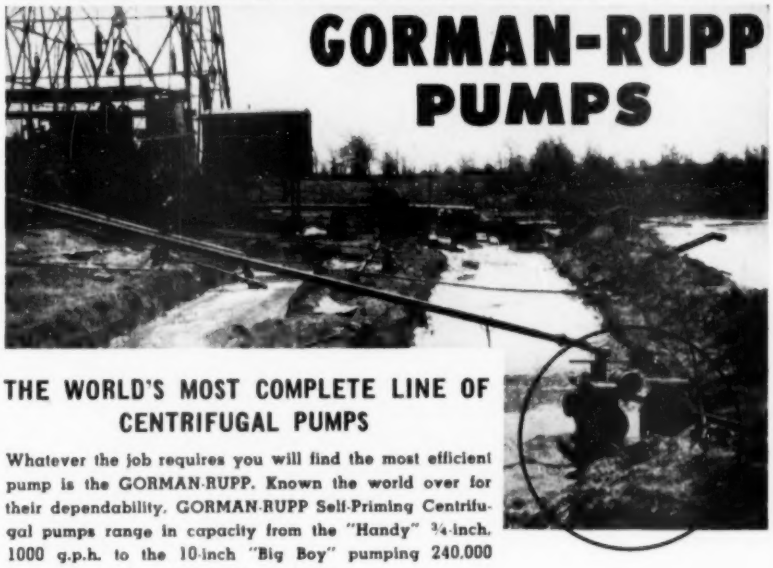

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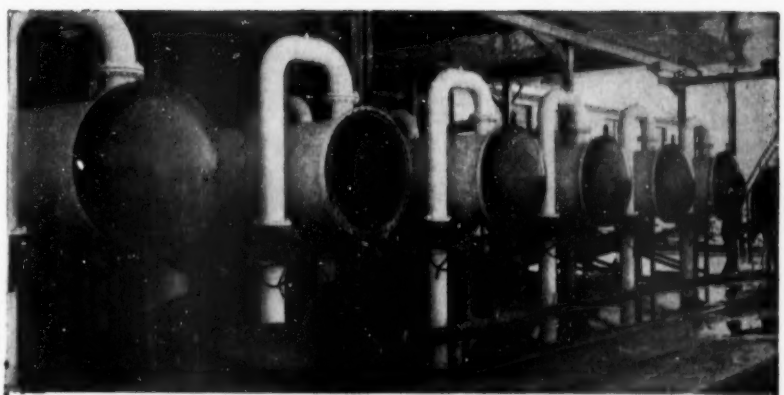

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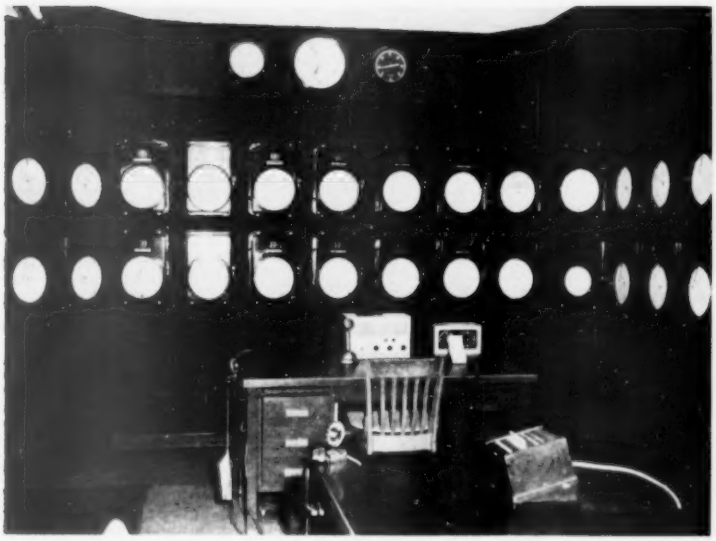

Fig. 1—Plant control room. Duplicate facilities in parallel in Control 1A and 1B. These two control rooms are located in separate structures several hundred feet apart.

Fig. 2—Telemeter receiver with polarized remote-control switch mounted on the gage panel.

Gas Transmission and Pressure Control

. . . on Niagara Mohawk system

New facilities permit reasonably balanced pressure control throughout system

by G. W. Day* and H. A. Anderson†

GAS operations in the Syracuse-Oswego areas of Niagara Mohawk Power Corp. include the cities of Syracuse, Fulton, and Oswego, N. Y., together with numerous nearby and along-the-line communities. All of the natural-gas requirements for the Syracuse-Oswego area are supplied by New York State Natural Gas Corp. at its Therm City metering and regulating station, located approximately 15 miles south of Syracuse.

A major construction program was begun on the Niagara Mohawk distribution system in the late forties. This will be substantially completed in 1953. As part of this expansion control facilities have been added to permit reasonably balanced pressure conditions throughout the Greater Syracuse medium-pressure loop system. The loop system in turn supplies, through district regulators, the exten-

(Continued on page 333)

*Supervisor, transmission and pressure control. †Superintendent, gas department, central division, Niagara Mohawk Power Corp.

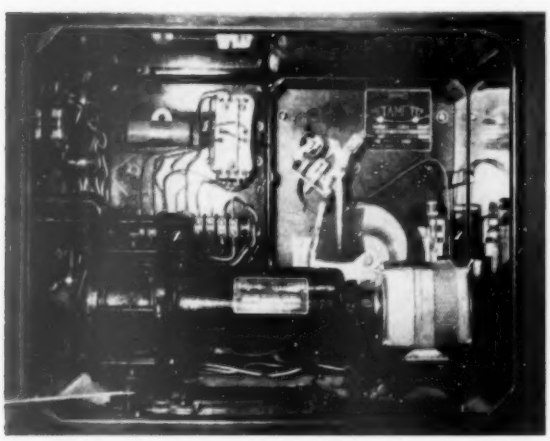

Fig. 3—Eight-pilot control, reversible motor, and polarized relays assembled in Model 500 case.

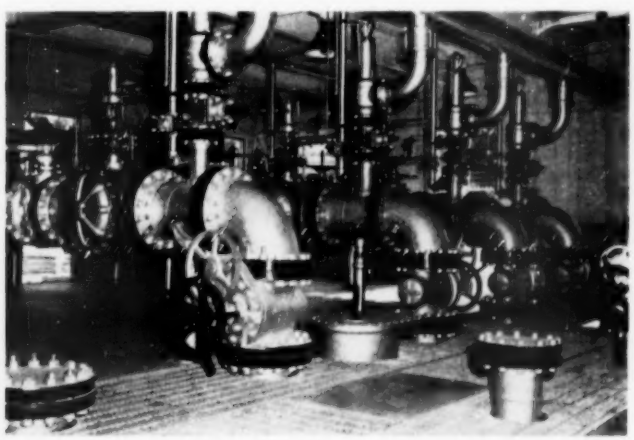

Fig. 4—Interior regulating station 71 at Taunton, N. Y., serving the low-pressure distribution network in the Syracuse-Oswego areas.

WELL CLEANOUT in Victory storage field. Here, Castle A. Weekly, foreman, and Lewis Wade, tool dresser, ready equipment for a well reconditioning. Wells were originally drilled for production in 1913-1925 period in this part of field.

NEW STORAGE PROJECT

Victory Field to Store Gas From Gulf Interstate Pipe Line

by S. G. Day*

A NEW gas-storage project is now under development by Manufacturers' Light & Heat Co.—a member of the Pittsburgh Group Companies, Columbia Gas System—in the old Victory field, located in Wetzel and Marshall counties, West Virginia. This project is of particular significance in that it will handle gas from the proposed Gulf Interstate Pipeline. This line will transmit gas at the rate of 375 million cubic feet per day and is scheduled to make its first deliveries in November 1954.

*Superintendent of production, Pittsburgh Group Companies, Columbia Gas System.

Victory field is a consolidation of two former producing areas which, together, helped supply gas to the West Virginia Panhandle for over 40 years.

Victory field, located in the northeast sector of the new storage field, was drilled from 1913 through 1925, while Proctor field, in the southwest sector, was drilled 23 years later, from 1936 to 1942.

Although the original gas reserves in the old fields are nearly depleted, the gas sands will make an ideal reservoir for storage. The sands are the Big Injun and Maxton, and average 2,000 ft. in depth. The permeability and porosity of the sands vary considerable throughout the field. But, on the average, they are comparable to similar sands in the Appalachian region.

Being close to Manufacturers' connections with some of its largest suppliers, Texas Eastern Transmission Corp. and United Fuel Gas Co., these fields are ideal for storage use. They are also near Manufacturers' principal transmission lines running north to its largest market areas — southwestern Pennsylvania, the Upper Ohio Valley, and the Beaver and Monongahela River areas.

Details of Storage Reservoir

Victory storage field is estimated to have a storage capacity in excess of 34 billion cubic feet at a pressure of 800 psi., and a deliverability of over 300 million cubic feet per day. Presently, there are 113 wells to be converted to storage, and ultimately the field will include approximately 200 wells, depending upon pressure studies of the wells. The field will cover over 32,000 acres.

When activated, the first storage deliveries in Victory, added to the relatively small amounts of gas remaining in the sands, will be held there permanently as cushion gas to provide pressure for the loads to follow.

Gulf Interstate . . . Development of the field is especially significant at this time because it will handle gas delivered to it from the proposed Gulf Interstate Pipeline. This pipe line will transport gas at the rate of 375 million cubic feet per day.

Gas from the proposed Gulf Interstate Pipeline will be transmitted from Louisiana to the United Fuel Gas Co., another Columbia Gas System firm, which operates in West Virginia and Kentucky.

Because the Columbia System operates on a "pool" system, all gas received from Gulf Interstate will be allocated to the various member firms.

At present, Manufacturers Light & Heat Co. has two pipe-line systems from which it takes gas from United Fuel. To handle the additional gas allocated it from the Gulf Interstate deliveries, Manufacturers has asked the Federal Power Commission for permission to construct 35 miles of new pipe line and to loop one of the existing lines.

Plans now before FPC call for 12.7 miles of 20-in. line to be constructed in Doddridge and Wetzel counties, and 21 miles of 12-in. line in Wetzel and Marshall counties, West Virginia.

They also include construction of smaller lines in Victory field; a com-

(Continued on page 334)

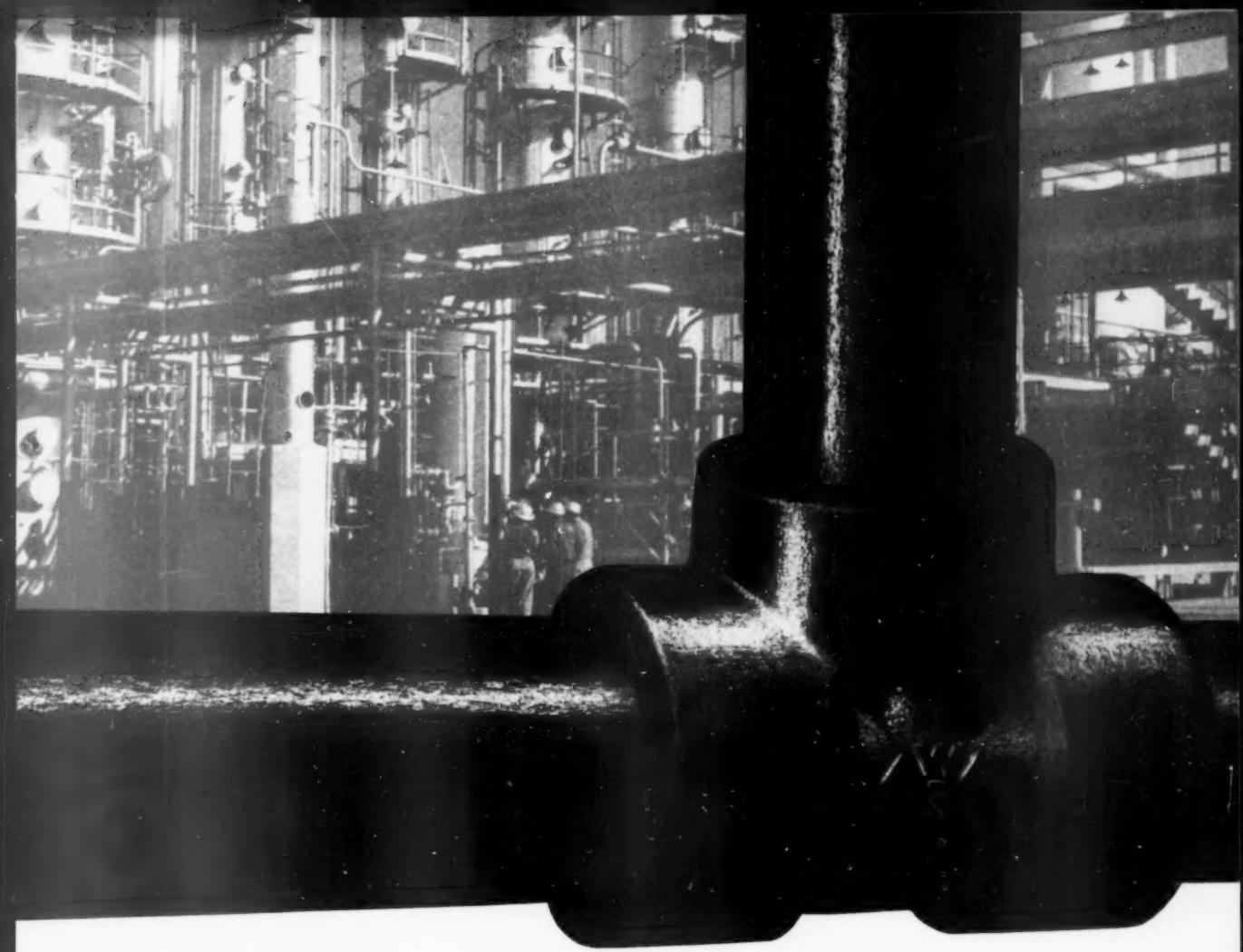

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Fig. 1—Two batteries of CO_2 cylinders. One battery releases automatically, the other is standby operated manually.

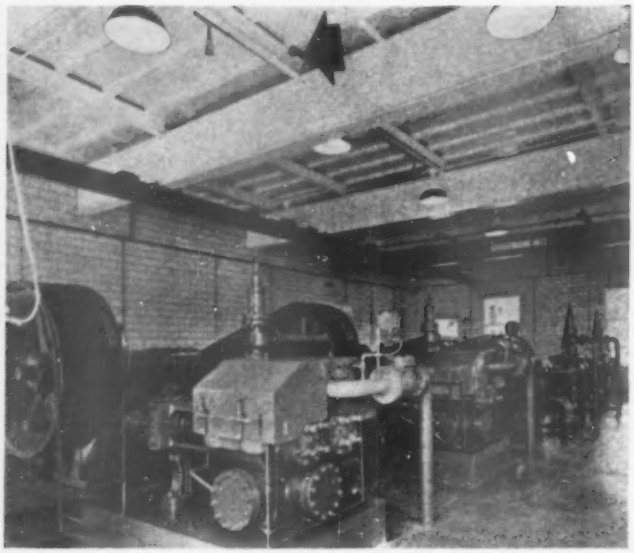

Fig. 2—Arrow points to heat-actuating devices. Diffuser-type nozzles are also installed at the ceiling.

FIRE PROTECTION—1953 MODEL

How Ohio Oil Safeguards Pumping Stations

Short water supply dictated automatic CO_2 system

by Charles F. Firmin*

DURING the summer of 1950 the pipe-line department of Ohio Oil Co. began a project of laying a new 20 and 22-in. pipe line between Wood River, Ill., and Lima, Ohio. The project was completed early in 1952. The new line replaced the old multiple small-line system between these two points and its larger capacity enabled the company to transport a greater quantity of oil with only 5 pump stations, than the old system with 16 stations.

The reduction from 16 to 5 stations, of course, resulted in better operating efficiency but it also made each of the 5 stations a much more vital link in the system than any of the 16 stations had been in the old system. This realization prompted the management to authorize the installation of fire-fighting systems to protect the pumping equipment at each of the five stations.

At the time the program was inaugurated, the water supply at three of the stations was not large enough to be effective in fighting fire. It was therefore decided to install automatic carbon dioxide systems in the pump rooms of the stations at Wood River, Patoka, Ill., and Elwood, Ind., all of which are electric stations.

*Assistant chief engineer, pipe-line department, Ohio Oil Co., Findlay, Ohio.

Wood River Installation

The system at Wood River is an example of this type of installation.

The automatic system consists of the following essential parts:

1. Cylinder assembly.
2. Cylinder valve operating heads.
3. Battery-mounting equipment.
4. Release mechanism.
5. Gas-discharge means.

Cylinder assembly . . . This consists of 31 cylinders, each containing 50 lb. of carbon dioxide gas. These cylinders are arranged in two rows of 16 and 15 cylinders. They are held in position in a battery supporting frame by metal cylinder clamps which can be readily removed for weighing or removing individual cylinders. This frame also supports the necessary manifold piping to which each cylinder is connected by a flexible discharge hose.

A standby battery of 31 cylinders is also provided. This is designed to be operated manually.

Two of the cylinders in the battery are equipped with lever-type operating heads and the remainder are equipped with pneumatic-type heads. When the release operates, a tripping weight is dropped which operates levers to open the valves of the two pilot cylinders. Gas escapes from the pilot cylinders into the manifold and its pressure operates the pneumatic-type heads on the remainder of the cylinders.

Heat detectors . . . In the pump room, which is 94 ft. long by 18 ft. wide by 17 ft. high, four heat-actuating devices are installed at ceiling height approximately 25 ft. apart. These actuators are connected by ⅛-in. copper tubing to the automatic Lowe release located at the cylinder battery. The actuators are the rate-of-rise type and will operate whenever the temperature rise exceeds a rate of 30° F. per minute. When a fire occurs, the heat expands the air in the actuators and pressure is transmitted to a diaphragm in the release box. Pressure on the diaphragm releases levers which cause the tripping

Fig. 3—Diffuser type nozzles mounted on wall and directed toward floor. Note the wall-mounted slotted screening-type nozzles directed toward window openings.

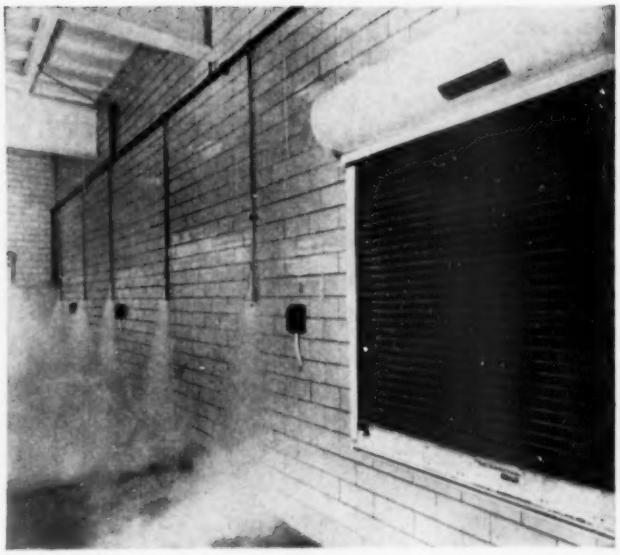

Fig. 4—Gas issuing from diffuser nozzles during test. At right note fire shutter which was released when system was actuated and has dropped to cover observation window between pump room and office.

weights to drop and open the lever-type valves in the heads of the pilot cylinders mentioned above.

Nozzles . . . The gas is distributed throughout the pump room through nozzles installed at the proper locations. This particular pump room is equipped with 30 diffuser-type nozzles and 22 slotted, screening-type nozzles. Ten of the diffuser-type nozzles are located on the center line of the pump room at ceiling height. There are 10 nozzles located along the outside wall, approximately 6 ft. above the floor and 10 nozzles similarly placed along the fire wall between the pump room and the motor room. The screening nozzles are used to blanket the window openings in case an explosion should blow out the windows. The doors are equipped with closing hardware, which consists of weights and pressure-operated latches. When the system operates, the pressure of the gas opens the latch and allows the weights to drop to close the door, should it be open at the time.

Similar installations have been installed at Patoka and Elwood.

Foam Installation

The relatively large size of the diesel stations at Martinsville, Ill., and Jamestown, Ind., required such a large number of cylinders for a carbon dioxide system, that their location became a problem and made this type of system less desirable. Also, since an adequate water supply could be made available at these two stations, it was decided to install foam systems. These have been ordered and will be installed in the near future.

It was decided that, if at all possible, an adequate water supply should be made available at each station and equipment installed to adequately protect all station buildings.

Fire-Fighting Water Supply

In order to supply water to the Wood River station, arrangements have been made to connect to a city water main adjacent to station property. Approximately 600 ft. of 6-in. line will be laid from this water main to a fire pump house. An engine-driven fire pump rated at 500 g.p.m. at 150 psi. will be installed. The fire pump will discharge into a 6-in. hydrant line, which will loop the station buildings. Seven 4-in. hydrants will be strategically placed in the 6-in. loop. Auxiliary equipment includes 300 ft. of 2½-in. fire hose, hose cart, water-fog nozzles, foam nozzles, and a supply of 3 per cent air-foam liquid.

Patoka . . . Two other pipe-line companies have stations adjacent to Ohio Oil's property at Patoka. A study is being made of the feasibility of installing some kind of fire fighting which can be used jointly.

At Martinsville . . . Here the foam system for the protection of the pump room will require 500 g.p.m. of water at 175 psi. An existing reservoir makes available an adequate water supply. In order to supply water for the stationary foam systems, and also for supplementary hose lines, a fire pump rated at 900 g.p.m. at 175 psi. will be installed. The portable equipment at this station also includes 2½-in. fire hose, water-fog nozzles, foam nozzles, hose carts,

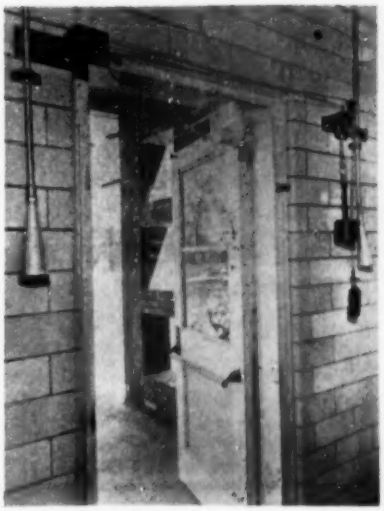

Fig. 5—In this photo may be seen door-closing mechanism which operates to close door when system is actuated.

and 3 per cent air-foam liquid. A 6-in. hydrant line is being laid around the station buildings with 4-in. hydrants at strategic locations.

Jamestown . . . This is also a diesel station. An adequate water supply is available from a creek which flows through the station property. Water from the creek flows into an existing suction well from which water is now taken to cool engine-jacket water. A fire pump is to be installed at this station to take suction on this well and furnish water for the stationary foam system in pump room and for supplementary hose lines. Pump is rated at 1,200 g.p.m. at 150 psi. Here, too, a

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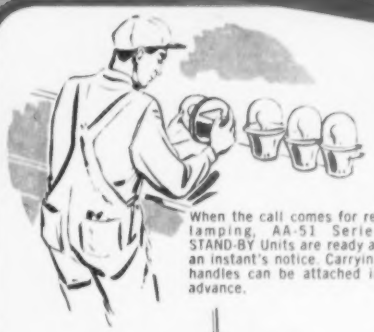

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hydrant line is being laid around all station buildings with 4-in. hydrants located at convenient spots. The portable equipment here also consists of 2½-in. fire hose, hose carts, water-fog nozzles, foam nozzles, and air-foam liquid.

Elwood . . . This station is located on the outskirts of the city of Elwood. The company will shortly lay approximately 3,500 ft. of 8-in. line from the nearest point of city water main to the station property. A hydrant line will also loop the station buildings and five 4-in. hydrants will be installed at convenient locations. The fire pump to be installed will be engine driven and be rated 500 g.p.m. at 150 psi. The portable equipment to be supplied to the station consists of 2½-in. fire hose, water-fog nozzles, foam nozzles, hose cart and 3 per cent air-foam liquid.

Lima, Ohio . . . The fire-fighting system at Lima was installed several years ago, and consists of a stationary water-fog system in the pump room and gate house. Hydrant lines loop all of the station buildings. A fire pump house was built to house the engine-driven, reciprocating fire pump and auxiliary equipment. The pump takes suction on a reservoir, which provides an adequate water supply. The hydrant system is also connected to a city water main which could be used in case of emergency. Portable equipment at Lima consists of 2½-in. fire hose, hose cart, water-fog nozzles, foam nozzles, and 3 per cent air-foam liquid.

East Sparta, Ohio . . . This is near Canton. The pump room is protected by an automatic carbon dioxide system similar to those installed at the Wood River, Patoka, and Elwood stations. An adequate water supply is available to provide supplemental protection to the CO_2 system from wells located on company property. Two 4-in. hydrants are to be installed in addition to one existing hydrant. The portable equipment consists of 2½-in. fire hose, water-fog nozzles, foam nozzles, and 3 per cent air-foam liquid.

Trunk and Gathering Facilities

Ohio Oil Co. operates trunk and gathering lines between Benton, Ill., in the southern part of the state and the main trunk at Martinsville. There are 7 trunk line stations and 17 gathering line stations. Only two of the trunk line stations can be supplied with an adequate quantity of water for fire-fighting purposes. These stations are located at Bridgeport and Stoy, and existing reservoirs will provide an adequate supply of water. It is planned to install hydrant lines looping the station buildings and to install at each location an engine-driven fire pump rated at 500 g.p.m. at 150 psi. The portable equipment at each location will consist of 2½-in. fire hose, water-fog nozzles, foam nozzles, hose cart, and 3 per cent air-foam liquid.

Dry-powder extinguishers . . . At the five trunk line stations which cannot be supplied with water, some changes have been made in the equipment to make them as fireproof as possible. In addition, portable dry-powder fire extingushers have been provided in numbers varying with the size and number of pump units at each station. These extinguishers are located outside the station building in a suitable box to protect them from weather. The pump units in most of these stations are engine-driven reciprocating pumps and not fewer than two 30-lb. dry-powder extinguishers have been provided for each unit.

Unattended stations . . . In the gathering system, in the Bridgeport division, most of the stations are automatic and operated completely unattended. In the unattended stations, sumps have been installed with a float-operated switch to shut down the pumping units in case of a sizable leak or a blown gasket inside the pump house. At each of these stations a heat-actuated shutdown device which will open the circuit and shut the station down in case a fire should occur is being installed. At each of these electrical stations, a manually operated switch is being installed outside the station building which can be pulled to shut the station down. All nonexplosionproof equipment is being replaced by Class 1, Group D equipment. Each station has been supplied with portable dry-powder extinguishers in the ratio of not less than two 30-lb. units per pump.

In the survey which was made to determine what equipment should be supplied and subsequently, during its installation, the pipe-line engineering department has worked in full cooperation with and guidance of the company's safety department.

Gas Transmission and Pressure Control

(Continued from page 327)

sive local low-pressure network, and nearby communities, as such pressures as may be necessary to satisfy requirements.

Primary control of pressures in the transmission and medium-pressure systems in the Syracuse-Oswego area rests entirely at centrally located control station designated as Control 1A. This is located on the site of an existing standby oil-gas plant and standby compressor plant. It is equipped with pressure telemetering receivers corresponding with strategically located pressure transmitters.

Other facilities included are: (1) the remote control of regulators discharging from the incoming transmission mains to the area transmission and medium-pressure systems; (2) remote control of holder filling valves in the Syracuse area; (3) short-wave radio in communication with the Therm City source, as well as gas operations vehicles, and (4) telephones, etc.

Control stations . . . Located in a separate structure several hundred feet from Control 1A is what is designated as Control 1B. (See Fig. 1). Here are control facilities which duplicate all of those located in Control 1A. The two control rooms continuously operating in parallel. In event Control 1A should be rendered inoperative, system control can instantly be taken over at Control 1B, which in addition to duplicate facilities is equipped with recording barometer, atmospheric temperature recorder and wind velocity-direction indicator.

Pressure telemetering transmitters with corresponding receivers in Control 1A, are located in all regulating stations remotely controlled from Control 1A to discharge from incoming high-pressure transmission mains into the Greater Syracuse medium-pressure loop system, or into secondary transmission mains interconnected with the loop system. Two simple pressure telemetering transmitters located at two stations in the system serve as aids to the operator at Control 1A, in the maintenance of a well-balanced and reasonably uniform pressure throughout the Greater Syracuse medium-pressure loop system.

As a result of the added pipe-line capacity and control facilities, a balanced pressure condition now prevails in this system which varies as load conditions necessitate from a reasonably uniform 3-psig. minimum to a maximum of 10 psig. on extreme peaks. Previously and under much lighter load conditions, a seriously unbalanced pressure condition prevailed throughout this system, which ranged from 6 to 7 psig. minimum to 20 psig. maximum at Control 1A, in order to maintain 1 to 2 psig. at the system low points.

Pilot Regulators

Pilot loaded regulators are installed in all systems remotely controlled. One

pilot head, designated Pilot 2, remains attached to the regulator to be controlled, to insure positive maintenance of a predetermined minimum discharge pressure. A second pilot head, designated Pilot 2 is remotely located in a structure separated from the regulator structure by distances which can range up to 150 ft. Copper tubing forms the communication between Pilot 2 and the regulator to be controlled.

The spring tension in Pilot 2 is increased or decreased within fixed limits as occasion requires, and thus the discharge pressure of the regulators increased or decreased by a small reversible a.c. motor, which is geared to operate at 3 r.p.m. The motor is actuated through movement by the operator in Control 1A of a polarized switch located within the Model 40 M pressure receiver case, which is mounted on the gage panel at Control 1A (See Fig. 2). Pilot 2, the small motor, and polarized relays, are all housed within a Model 500 strip chart case, in turn flush mounted on the gage panel at the regulator station site (See Fig. 3).

Telephone lines used for transmission between instruments in the field and corresponding instruments in Control 1A are leased in pairs. Where a single operation is involved, such as between a pressure transmitter at a station in the field and a corresponding receiver at Control 1A, the complete metallic circuit is used. Where two operations are involved at the same station in the field, such as pressure transmission and remote control, one wire and ground return is utilized for each of the two operations.

Victory Field to Store Gas From Gulf Interstate

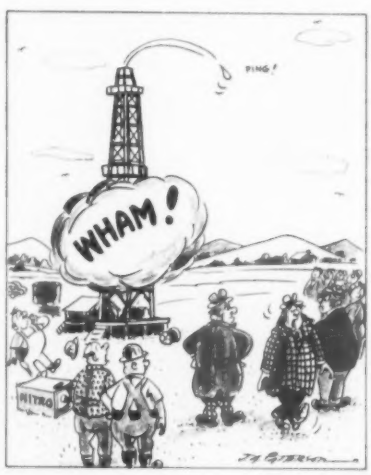
(Continued from page 328)

pressor station; metering and regulating stations, and other facilities necessary for the activation and operation of the field.

Compressors . . . Plans have also been completed for a $500,000 compressor station to provide pressure for storage deliveries. The station will have 1,760 hp., a working pressure of 1,000 psi., and a daily capacity of 20,000,000 cu. ft. It will be located at Adeline, W. Va., 6 miles south of Cameron.

These projects will be just the beginning of the construction that will result from the new Gulf Interstate line. With the additions to its U.F.G. receiving system, Manufacturers will be able to make substantial storage deliveries. But additional lines will be needed to move the gas from the storage field to market.

When completed, Victory storage field will serve a twofold purpose. First, it will act as a safeguard to protect consumers from shortages which could result from supplier company line failures. And, most important, it will make possible the operation of Manufacturers' own transmission lines at a high load factor and thereby make more gas available to the public.



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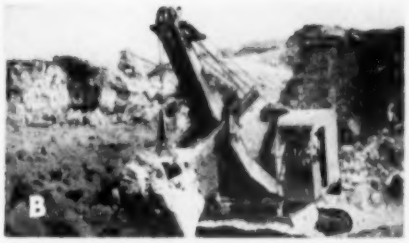

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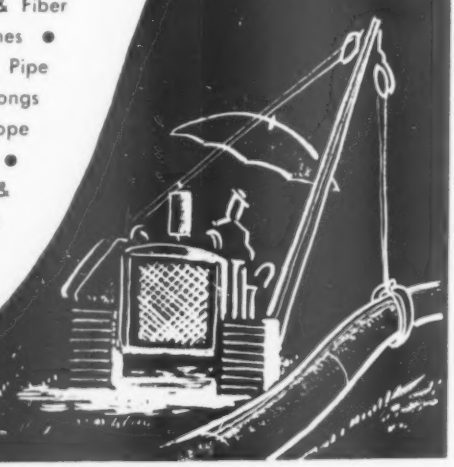

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Pipe-Line Report: Continued Construction Expansion

by Paul Reed

PIPE-LINE-CONSTRUCTION activity in the United States and Canada continues on the large scale which is characteristic of the current period of expansion.

Natural-gas projects predominate with proposals for future undertakings totaling approximately 20,900 miles. Plans are being made for 2,900 miles of products lines and for 1,600 miles of crude-oil lines. The total of proposals which have been announced for all types of lines is 25,400 miles. This does not include several projects totaling 4,300 miles of uncertain prospects but does include a number of conflicting rival proposals.

Work contracted and under way totals 7,300 miles. Of this, 4,500 miles is for natural-gas lines, 1,500 miles for crude-oil lines, and 1,300 miles for products lines.

The largest programs which are now being shaped up for future construction are American Louisiana Pipe Line Co.'s 1,000-mile, 30-in. line from the Gulf Coast to Detroit, and Tennessee Gas Transmission Co.'s 904-mile looping and extension proposal in connection with plans for exporting gas to Ontario.

Pacific Northwest Pipe Line Corp. and Westcoast Transmission Co., Ltd., are making rival efforts to get authorization for the privilege of building the big system for supplying natural gas to Washington and Oregon.

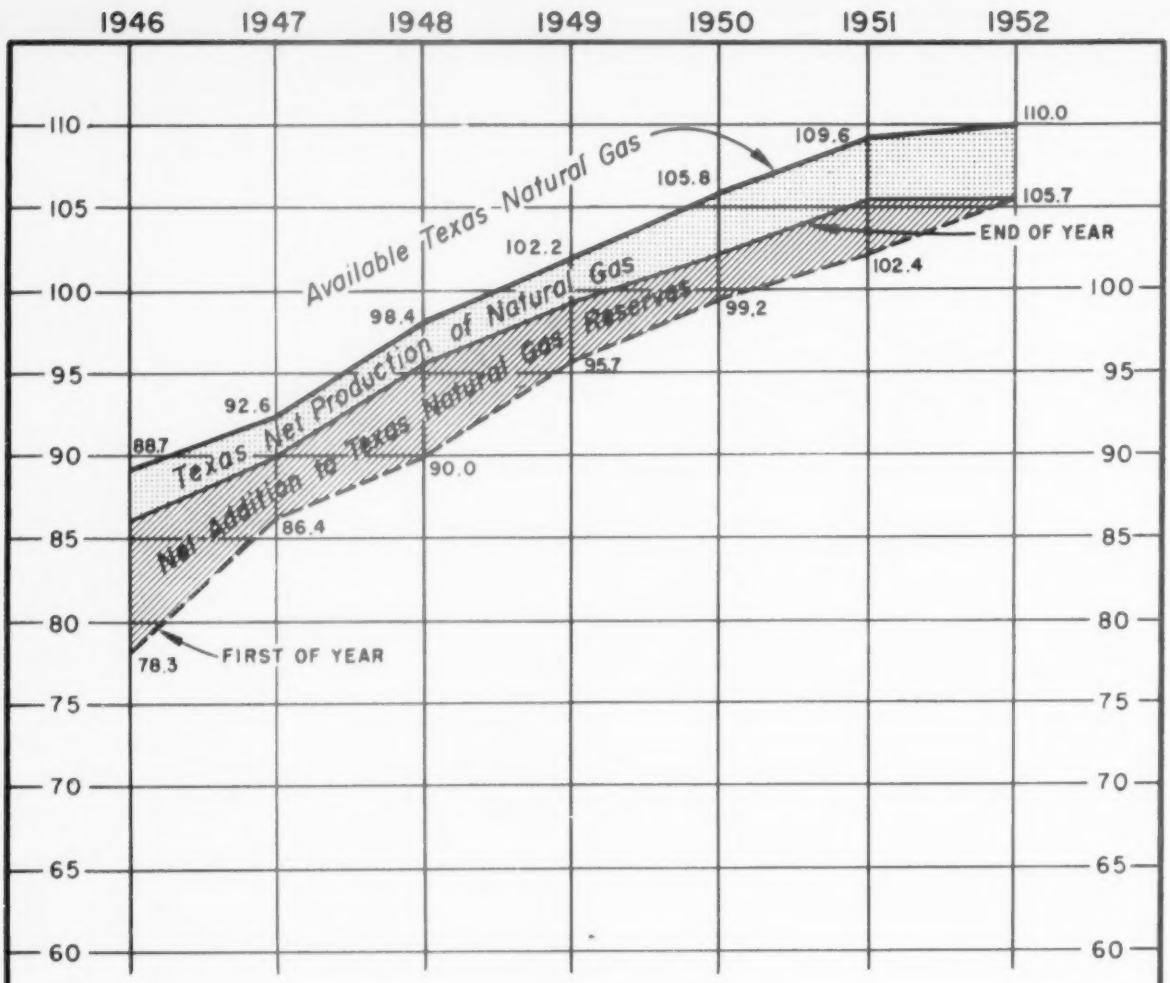
Notable in this year's activity is Lakehead Pipe Line Co.'s 644-mile line being completed within the 1953 construction season. This is the first crude-oil project built in the United States with diameter as large as 30-in.

The big gas projects now being laid are Gulf Interstate Gas Co.'s 1,419 miles; El Paso Natural Gas Co.'s 1,178 miles, and the undertakings of Northern Natural Gas Co. and its affiliate Permian Basin Pipeline Co., totaling 536 miles. Southern Natural Gas Co. is in the process of completing a 1,235-mile program carried out in the last 2 years.

Widespread products pipe-line construction now under way includes two projects of Standard Oil Co. (Indiana) totaling 445 miles; Wolverine Pipe Line System's 200 miles; Kaneb Pipe Line Co. and Augusta Pipe Line Co.'s total of 289 miles; Sun Pipe Line Co. of Canada's 200 miles; Salt Lake Pipe Line Co.'s 180 miles and Plantation Pipe Line Co.'s 82 miles.

U. S. and Canadian Natural-Gas Pipe-Line Projects Planned and Under Way

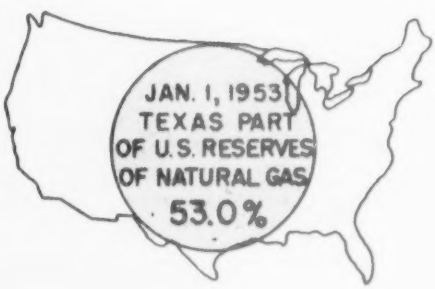
Company—	Miles	Inch	Status	Contractor and route
American Louisiana Pipe Line Co.	1,000	30	Proposed	Lowry, La., to Detroit, Mich.
Arkansas-Missouri Power Co.	140	2-10	Planned	St. Francis River, Clay County, Arkansas, to near Campbell, Mo.
Associated Natural Gas Co.	88		Proposed	Missouri.
Atlantic Seaboard Corp.	29	26	Proposed	Looping along Cobb-Rockville, Md., line.
Carolina Natural Gas Corp.	185	2-12	Proposed	North and South Carolina.
Chattahoochee Natural Gas Co.	70		Proposed	Floyd County, Georgia, to Dalton, Ga.
Chicago District Pipe Line Co.	31	24-30	Proposed	East bank of Des Plaines River southwesterly to near Hodgkins, Ill., on through Cook County to Will County, Illinois.
Cities Service Gas Co.	18	16	Proposed	Lawrence and Newton counties, Missouri.
Cities Service Gas Co.	69	20-16	Proposed	Cleveland, McClain, and Garvin counties, Oklahoma.
City of Fayette, Ala.	20	5	Proposed	Fayette, Ala., to Southern Natural's system in Tuscaloosa County, Alabama.
Coast Counties Gas & Electric Co.	40	3-4-8	Planned	Coast and Valley region, California.
Colorado Interstate Gas Co.	365	22	Proposed	Green River, Wyo., to Denver. Sched. comp. 1954.
Colorado Interstate Gas Co.	243	4-20	Proposed	Colorado, Oklahoma, Texas, and Kansas.
Cumberland & Allegheny Gas Co.	31	12	Proposed	Garrett County, Maryland, to Keyser, W. Va.
East Tennessee Natural Gas Co.	158	16	Under way	Knoxville to Kingsport, Tenn. Sched. comp. 11-53.
El Paso Natural Gas Co.	1,178		Proposed	Permian basin, New Mexico, Texas, and Colorado.
El Paso Natural Gas Co.	771	30	Under way	**R. H. Fulton-Western-Oklahoma-Company Crews.**—Plains, Tex., to Kingman, Ariz.
Fort Worth Basin Gas Co.			Planned	Novice, through Brown and Comanche counties, Texas.
Glacier Gas Co.	285	20	Proposed	Kalispell, Mont., to Spokane, Wash.
Glacier Gas Co.	120	16	Proposed	Spokane to Hanford, Wash.
Glacier Gas Co.	91	8	Proposed	Spokane to Lewiston, Idaho.
Glacier Gas Co.	130	12¾	Proposed	Spokane to international boundary at Trail, B. C.
Gulf Interstate Gas Co.	860	30	Under way	**H. C. Price and Houston Contr.**—Acadia Parish, Louisiana, to Boyd County, Kentucky. Sched. comp. 11-54.
Gulf Interstate Gas Co.	230		Contracted	**Associated P. L.-Anderson Bros.-Williams Bros.**—Gathering lines.
Gulf Interstate Gas Co.	329	12-24	Proposed	Laterals off Acadia Parish, Louisiana, to Boyd County, Kentucky, line.
Home Gas Co.	32	12	Planned	Breesport to Union Center, N. Y.
Home Gas Co.	46	12	Under way	**H. L. Gentry.**—Tioga and Broome counties, New York.
Home Gas Co.	22	12-16	Under way	Binghampton, N. Y.
Interstate Power Co.	26	8	Proposed	From Natural Gas Pipeline Co. of America to line near Hooppole, Ill., to Clinton, Iowa.
Iowa-Illinois Gas & Electric Co.	41	10	Proposed	Washington County to Cedar Rapids, Iowa.
Kansas-Nebraska Natural Gas Co., Inc.	54	4-6	Under way	**Brodie Constr.**—Neligh to Hartington, Neb. Sched. comp. 9-53.
Kansas-Nebraska Natural Gas Co., Inc.	42	4-6	Under way	**Brodie Constr.**—Neligh to O'Neill. Sched. comp. 9-53.
Kansas-Nebraska Natural Gas Co., Inc.	61	3-2	Under way	**Brodie Constr.**—Laterals from Bloomfield through various towns to Wausa, Neb.
Kansas-Nebraska Natural Gas Co., Inc.	41	4-6	Proposed	Kansas and Nebraska.
Lone Star Gas Co.	100		Proposed	Storage field to the Dallas-Fort Worth area.
Lone Star Gas Co.	35	12	Proposed	Southeastern Schleicher County.
Lone Star Gas Co.	36	12	Planned	Stamford to Abilene, Tex.
Lone Star Gas Co.	44	12	Under way	Red Springs, Woods County, to Sulphur Springs area, Hopkins County, Texas.



TEXAS
NATURAL GAS RESERVES

(IN TRILLIONS OF CUBIC FEET)

SOURCE: U. S. BUREAU OF MINES
AND AMERICAN GAS ASSOCIATION



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TEXAS–LOUISIANA NATURAL GAS

U. S. and Canadian Natural-Gas Pipe-Line Projects Planned and Under Way (Continued)

Company—	Miles	Inch	Status	Contractor and route
Manufacturers Gas, Light & Heat Co.	72	16-20	Proposed	Doddridge, Wetzel, and Marshall counties, West Virginia.
Manufacturers Gas, Light & Heat Co.	40		Proposed	Allegheny, Washington, and Beaver counties, Pennsylvania.
Manufacturers Gas, Light & Heat Co.	213	3-26	Proposed	Various points on system in Pennsylvania, West Virginia, and Ohio.
Mid-Continent Pipelines, Ltd.	1,860	30	Proposed	**Fish Engr. Co.**—Alberta to Montreal, Canada.
Mississippi River Fuel Corp.	109	10-18	Planned	Laterals in Woodlawn and Waskom gas fields, Texas.
Missouri Central Gas Co.	25	6	Contracted	**L. R. Young Const.**—Moberly to Macon, Mo.
Missouri Public Service Co.	136	8-10	Proposed	New Franklin to Trenton, Mo.
Missouri Public Service Co.	24	10	Proposed	Johnson County to Clinton, Mo.
Montana Power Co.	52	16	Planned	Canada-Montana border to Cut Bank, Mont.
Morganfield Natural Gas Co.	31	4-6	Planned	Through Sturgis, Providence, Clay, Diamond, Wheatcroft, and Sullivan, Ky.
Natural Gas Producers, Inc.	100	12	Planned	Yenter pool to Denver.
Nevada Natural Gas Pipe Line Co.	114	12¾	Planned	Topock, Ariz., to Las Vegas, Nev.
New River Gas Co.	50		Planned	Summers and Monroe counties, West Virginia, to Narrows and Dublin, W. Va.
New York State Electric & Gas Co.	59	8-10-24	Proposed	Oneonta and Norwich to DeRuyter, N. Y.
Northwest Natural Gas Co.	950	24	Planned	Alberta fields to Vancouver, B. C., Seattle, Wash., and Portland, Ore.
Northern Indiana Fuel & Light Co.	33	8	Proposed	Edgerton to Auburn, Ind.
Northern Natural Gas Co.	458		Proposed	Kansas, Texas, Oklahoma, Nebraska, Iowa, and Minnesota.
Northern Natural Gas Co.	475		Proposed	Iowa, Nebraska, Minnesota, and South Dakota.
Northern Natural Gas Co.	400	24	Proposed	Emerson, Man., south to Red River Valley through Fergus Falls on to St. Paul, Minn.
Northern Natural Gas Co.	92	30	Under way	**R. H. Fulton.**—Dumas via Sunray to main line north of Canadian River, Texas, and two loops near Beaver station, Oklahoma.
Northern Natural Gas Co.	70	30	Contracted	**Lone Star Constructors.**—Mullinville, Bushton, and Clifton station, Kans., and Palmyra sta., Neb. (loops).
Northern Natural Gas Co.	94	24-30	Contracted	**G. G. Griffis Const. Co.**—Loops near Paulina, Ogden, and Oakland stations, Iowa.
Northwest Natural Gas Co.	750		Planned	Washington, Oregon, and Idaho.
Ohio Fuel Gas Co.	31	20	Planned	Licking County to Richland County, Ohio.
Ohio Fuel Gas Co.	22	16	Planned	Dayton, Troy, Piqua, and Sidney, Ohio.
Ohio Fuel Gas Co.	23	16-20	Planned	Wellington to Elyria, Ohio.
Ohio Fuel Gas Co.	74	3-20	Planned	Hocking, Knox, and Ashland counties, Ohio.
Ohio Fuel Gas Co.	47	20	Planned	Benton Township, Hocking County, to Columbus, Ohio.
Ohio Fuel Gas Co.	61		Planned	Northern and southwestern Ohio.
Ohio Fuel Gas Co.	33	20	Proposed	Jefferson to Seneca, Ohio.
Ohio Fuel Gas Co.	69	20-24	Proposed	Lines to tie in Gulf Interstate line along various points in Lawrence, Jackson, Vinton, Hocking, and Fairfield counties, Ohio.
Pacific Gas & Electric Co.	50	12-16-20	Planned	Fresno to Merced, Calif.
Pacific Gas & Electric Co.	170	34	Proposed	Looping—Topock, Ariz., to Milpitas, Calif.
Pacific Northwest Pipeline Corp.	1,466		Proposed	Ignacio, Colo., to Bellingham, Wash.
Pacific Northwest Pipeline Corp.	380		Proposed	Laterals and spurs off main line to Pocatello, Idaho, to Yakima, Wash.
Permian Basin Pipeline Co.	280	16-24-26-30	Under way	**R. H. Fulton.**—West Texas and New Mexico.
Phillips Petroleum Co.	28	10	Under way	**Massey Const.**—Bayou plant to Adams terminal.
Rockland Light & Power Co.	22	8	Proposed	Orangetown to Tompkins Cove, N. Y.
Shenandoah Gas Co.	39	3-4-8	Proposed	Middleton, Va., to Martinsburg, W. Va.
South Carolina Natural Gas Co.	160	16-12-10	Proposed	Aiken, S. C., to Columbia, Summerville, and Charleston, S. C.
South Georgia Natural Gas Co.	339	2-12	Planned	Phoenix, Ala., to Tallahassee, Fla.
Southern California Gas Co. and Southern Counties Gas Co.	73	30	Planned	Loops on main line from Blythe to Los Angeles.
Southern Natural Gas Co.	1,235	24-4½	Under way	**Houston Contracting and H. C. Price.**—Louisiana, Mississippi, Alabama, Georgia, and South Carolina.
Southwest Gas Corp., Ltd.	26		Proposed	From P. G. & E. line to Victorville, Calif.
Tennessee Gas Transmission Co.	574	30	Proposed	Kinder, La., northeast through Louisiana and Mississippi, to Portland, Tenn.
Tennessee Gas Transmission Co.	130		Proposed	Looping in Texas and Louisiana.
Tennessee Gas Transmission Co.	63	26	Proposed	Loops near Greenup, Ky., to Mercer, Pa.
Tennessee Gas Transmission Co.	45	20	Proposed	Buffalo, N. Y., to the U. S.-Canadian border Hamburg station near St. Catherines.
Tennessee Gas Transmission Co.	20	30	Under way	**Oklahoma Contr.**—Natchitoches, La., to Goldonna, La.
Tennessee Gas Transmission Co.	18	30	Under way	**Oklahoma Contr.**—Middletown to Selmer, Tenn.
Tennessee Gas Transmission Co.	35		Contracted	**Western P. L. Constr.**—Campbellsville, Ky., to Danville, Ky.
Tennessee Gas Transmission Co.	21	26	Under way	**Western P. L. Constr.**—Carter, Ky., to Ohio River.
Tennessee Gas Transmission Co.	70	24	Under way	**H. C. Price Co.**—Mercer, Pa., to Pigeon near Coudersport, Pa.
Tennessee Gas Transmission Co.	60	24	Under way	**Bechtel Corp.**—Pigeon, Pa., to Hebron field, Porter County, Pennsylvania.
Texas-Ohio Gas Co.	1,435	30	Proposed	Hidalgo County, Texas, through Arkansas, Mississippi, Tennessee, and Kentucky on to Spencer, W. Va.
Trans-Canada Pipe Lines, Ltd.	2,247	14-30	Proposed	Alberta to Toronto to Montreal, Canada.
Trans-Canada Pipe Lines, Ltd.	747	8-24	Proposed	Gathering system in Alberta.
Trans-Northwest Gas, Inc.	246		Proposed	International boundary near Osoyoos, B. C., to Washington and Idaho.
Trans-Northwest Gas, Inc.	275		Planned	Branch lines in Washington and Idaho.
United Fuel Gas Co.	50	20-24	Proposed	Wood County to Lanham, W. Va.

U. S. and Canadian Natural-Gas Pipe-Line Projects Planned and Under Way (Continued)

Company—	Miles	Inch	Status	Contractor and route
United Fuel Gas Co.	32	24	Proposed	Near Ripley, W. Va., to Lanham station, Putnam County, West Virginia.
United Gas Pipe Line Co.	44	20	Planned	Lirette field to Harvey, La.
United Natural Gas Co.	50	12	Planned	Elk County to Jefferson County, Pennsylvania.
Utah Natural Gas Co.	103	16-18	Proposed	Clear Creek field near Price to Salt Lake City, Utah.
Virginia Natural Gas Co.	153		Proposed	Buckingham to Richmond and Portsmouth, Va.
Westcoast Transmission Co., Ltd.	1,110	24	Planned	Dawson Creek, B. C., through Pine Pass to Fraser River Valley to Kamloops, Princeton, and Vancouver to Portland, Ore.
Westcoast Transmission Co., Ltd.	280	20	Planned	Pincher Creek to Montana on to Spokane, Wash.
Westcoast Transmission Co., Ltd.	138	20	Planned	Sumas to Tacoma, Wash.
Westcoast Transmission Co., Ltd.	139	18	Planned	Tacoma, Wash., to Portland, Ore.
Western Pipe Lines	833	24	Proposed	Southern Alberta, eastward across the Canadian prairies serving principal towns and cities along the route.

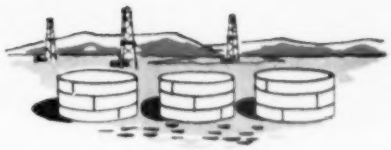
U. S. and Canadian Crude-Oil Pipe-Line Projects Planned and Under Way

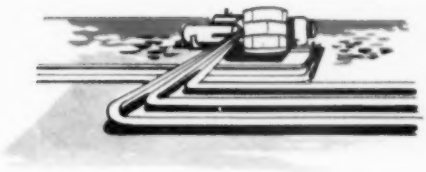
Company—	Miles	Inch	Status	Contractor and route
California-Oregon Pipe Line System	103	6	Proposed	Crescent City, Calif., to Medford, Ore.
R. A. Goodall	45	6	Planned	Little Beaver to Merino, Colo. (to connect with Sterling System).
Gulf Refining Co.	55	12	Planned	Bay Marchand to Plaquemines, La.
Humble Pipe Line Co.	71	16-18	Under way	**O. R. Burden.**—East Texas to Louisiana-Texas border. Sched. comp. 10-53.
Interstate Oil Pipe Line Co.	107	22	Under way	**River Const. Corp.**—Shreveport to Baton Rouge, La. Sched. comp. 10-53.
Interstate Oil Pipe Line Co.	55	16	Under way	**L. E. Farley.**—Raceland to Anchorage, La.
Lakehead Pipe Line Co.	644	30	Under way	**Anderson; Mahoney; Midwestern; Meagher; Conyes; Bechtel; Merritt, Chapman & Scott Corp.**—Superior, Wis., to Sarnia, Ont., Canada.
Magnolia Pipe Line Co.	29	8	Planned	Midland County, Texas.
Magnolia Pipe Line Co.	154	16	Under way	**H. B. Zachry.**—Corsicana to Ringgold, Tex.
Michi, Inc.		10	Planned	Highland, Ind., to Kalamazoo, Alma, and Elsie, Mich.
Pasotex Pipe Line Co.	146	10	Planned	Snyder to Wink, Tex.
Phillips Pipe Line Co.	26	8	Under way	Northeast area of Andrews County, Texas.
Phillips Pipe Line Co.	18		Under way	Gathering lines in Andrews County, Texas.
Progress Pacific Pipeline Co.	1,100	24	Planned	Odessa, Tex., to Los Angeles Harbor, California.
Roosevelt Oil & Refining Corp.	22	4-6	Planned	St. Helens to Norwich, Mich.
Saskatoon Pipe Line, Ltd.	56	6	Planned	Milden to Saskatoon, Sask., Canada.
Service Pipe Line Co.	153	12-16	Under way	**O. R. Burden.**—Tioga-Beaver Lodge area to Mandan, N. D.
Service Pipe Line Co.	55	4-6-8	Under way	**C. P. Bartley.**—Tioga-Beaver Lodge area gathering system.
Texas New Mexico Pipe Line Co.	52	10	Contracted	**McVean-Barlow.**—Dawson County to Basin System.
Texas Pipe Line Co.	34	6	Under way	**Houston Contr.**—Sour Lake to Port Arthur, Tex.
Texas Pipe Line Co.	45	8-10	Under way	**Houston Contr.**—Between Erath and Bayou Sale stations.
Trans Mountain Oil Pipe Line Co.	30		Planned	Vancouver, B. C., terminal to Ferndale, Wash.
West Coast Pipeline Co.	960	20-22	Planned	Wink, Tex., to Norwalk, Calif.

U. S. and Canadian Products Pipe-Line Projects Planned and Under Way

Company—	Miles	Inch	Status	Contractor and route
Augusta Pipe Line Co.	43	8	Under way	**Ray L. Smith.**—Arkansas City to Augusta, Kans.
H. W. Bass & Sons, Inc.	152	4-6	Proposed	Duval and Live Oak counties, Texas, to Corpus Christi, Tex.
Great Lakes Pipe Line Co.			Proposed	Extension to Grand Island, Neb.
Harbor Products System	86	16	Under way	**Construction Service and H. C. Price.**—Philadelphia to Trembley Point, N. J.
Kaneb Pipe Line Co.	246	8-10	Under way	**Ray L. Smith.**—Wichita, Kans., to Fairmont, Neb.
Phillips Petroleum Co.	54	6	Planned	Goldsmith to Borger, Tex.
Phillips Petroleum Co.	52	10	Planned	Shell's Bookshire System to Sweeny, Tex.
Plantation Pipe Line Co.	82	14	Under way	**Anderson Bros.**—Charlotte to Greensboro, N. C.
Salt Lake Pipe Line Co.	140	8	Under way	**Lyles & Young.**—Pasco to Spokane, Wash. Sched. comp. 10-1-53.
Salt Lake Pipe Line Co.	40	6	Planned	Adams, Ore., to Pasco, Wash.
Standard Oil Co. (Ind.)	205	10	Under way	**Associated Pipe Line Contrs.**—Mandan, N. D., to Moorehead, Minn. Sched. comp. 12-53.
Standard Oil Co. (Ind.)	243	10-12	Under way	**Somerville, Morrison; Potashnick and Coolsaet.**—Whiting, Ind., to River Rouge, Mich.
Sun Pipe Line Co. of Canada	200	8	Under way	**Williams Bros.**—Sarnia, Hamilton, Toronto, Ont., Canada. Sched. comp. 10-53.
Sunray Oil Corp.	440	10	Planned	Duncan, Okla., to Mississippi River.
Sun Pipe Line Co.	50	8	Under way	**Coolsaet; Poston P. L.**—Toledo to Inkster Junction west of Detroit. Sched. comp. 10-53.
Triangle Pipe Line Co.	560		Proposed	Arkansas City, Ark., to Covington, Ky., and Nashville, Tenn.
United States and Canadian Governments	600	8	Planned	Haines to Fairbanks, Alaska.
United States Pipe Line Co.	1,799	22-26	Proposed	Beaumont, Tex., to Newark, N. J.
Williston Basin Pipe Line Co.	244	8	Proposed	Laurel-Billings, Mont., refineries to Glendive, Mont.
Wolverine Pipe Line System	200	14	Planned	**Midwestern and Anderson.**—Chicago to Toledo and Detroit. Sched. comp. 1-54.
Yellowstone Pipe Line Co.	540	10	Planned	Billings, Mont., to Spokane, Wash.

PREVENTS CORROSION AND RUST FORMATION IN STORAGE TANKS, PRODUCTS PIPE LINES AND TANKERS





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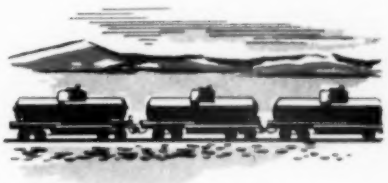
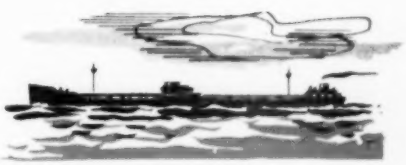
Kontol 77 has no harmful effects on product quality. For example 100/130 octane gasoline, treated with 14 p.p.m. shows no change in color, octane number, accelerated gum, precipitated lead or other av-gas specifications.





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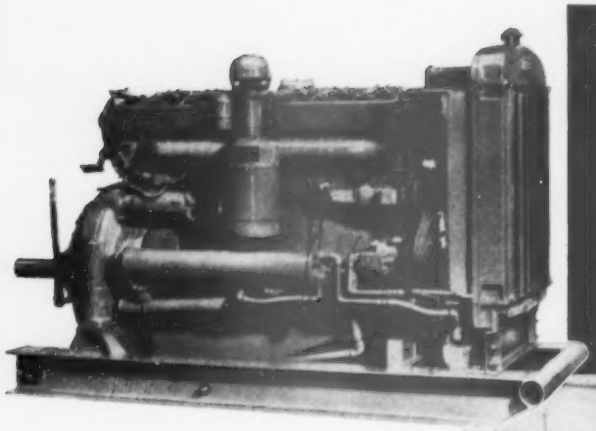

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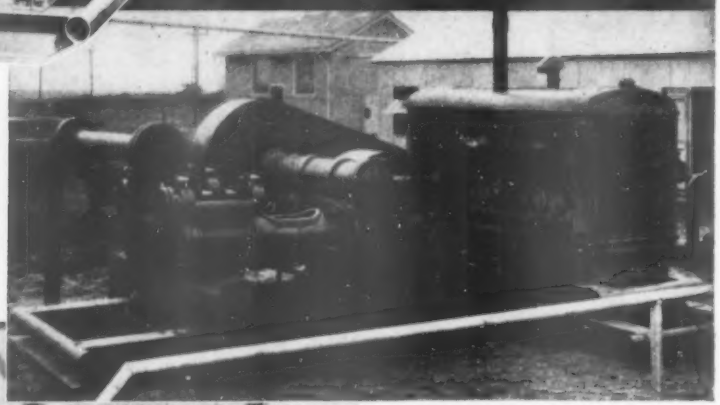

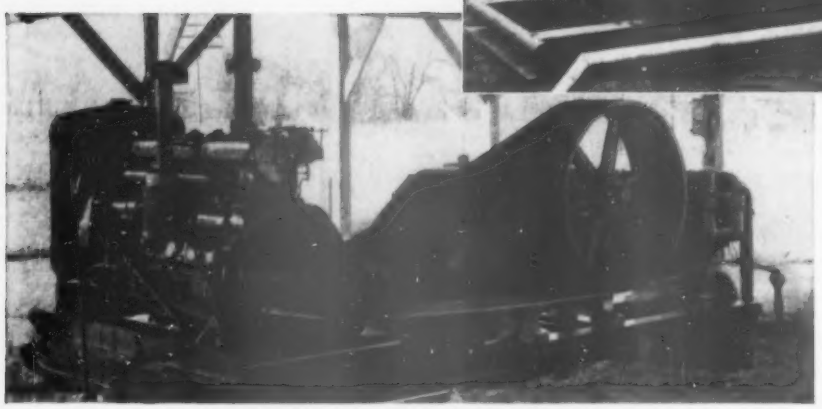

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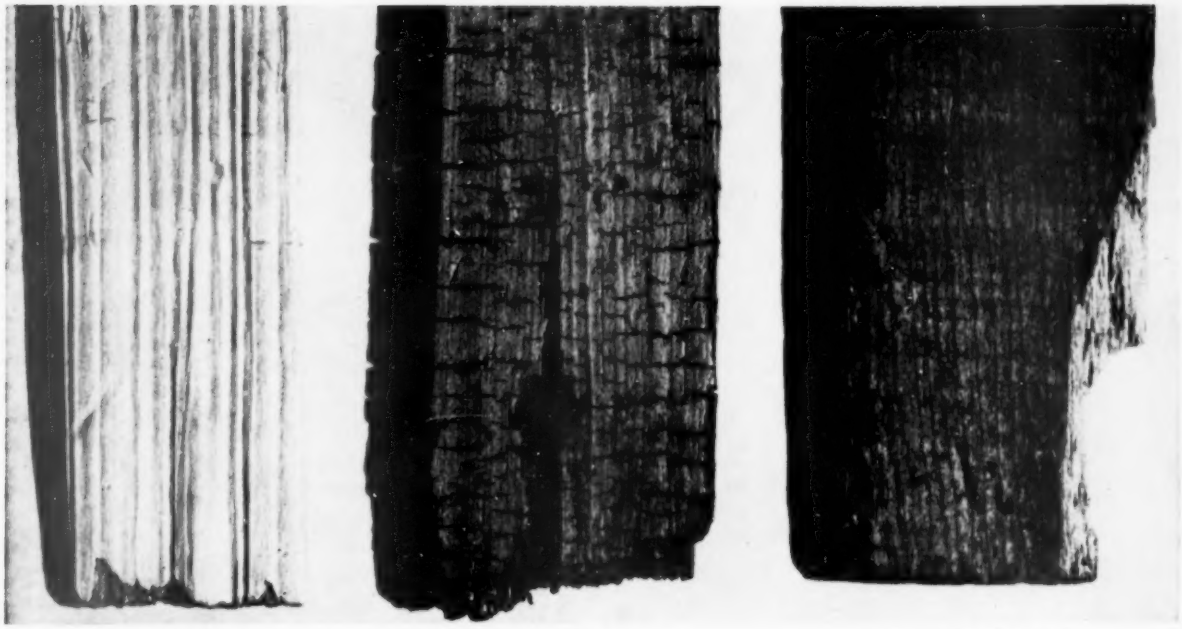

White surface wood
(Chemical attack)

Checked wood
(Fungal attack on surface of fill)

Fungus-attacked wood
(Fungal attack on interior of members)

Examples of major types of deterioration.

REDWOOD COOLING TOWERS . . . *A look at causes of deterioration and methods of maintenance*

by Roy F. Comeaux*

THE mist-eliminator section of a redwood cooling tower failed at Humble's Baytown refinery after only 6 years of service. The failure was due primarily to attack by wood-destroying fungi. It was found that this attack was occurring in essentially all of the Baytown towers, and also that the continuously flooded members were undergoing direct attack by chemicals. Complete failures of cooling towers have occurred in 11 to 18 years; the average life of the fill or packing has been only 11.5 years.

Chemical attack is affected by alkalinity, temperature, and the severity of chlorination. Some of the factors affecting rate of fungal attack, are air, water, food, and temperature conditions. The two forms of attack are not entirely independent; both have been observed to predominate on the same wood members at different periods as conditions in the towers change.

*Senior research chemist, Humble Oil & Refining Co., Baytown, Tex. Paper presented to session on corrosion during mid-year meeting of Division of Refining, A.P.I., May 1953.

Cooling-Tower Life

The life of individual cooling towers at Baytown has varied considerably. The variations may be attributed to: (1) type of tower (percentage of wood exposed to attack by fungi, at favorable moisture contents and temperatures); (2) differences in operating conditions (hot-water temperature, water-treating procedures, type of makeup, etc.), and (3) underdesign of critical structural members. Complete failures of cooling towers have occurred in 11 to 18 years; the average life of the packing or fill has been only 11.5 years. It is the opinion of most operators that the construction of cooling towers should be such that a life of at least 20 years will be realized.

Although it is known that wood-destroying fungi are attacking the fill in a number of towers, fill destruction is due chiefly to surface attack by chemicals. While chemical attack occurs on all wood and may be a forerunner of attack by organisms, the drift eliminators are destroyed primarily by fungi; the damage is on the interior of the redwood members. Fungi damage is not appreciable at temperatures above 105° F. Both types of attack occur on the casings of essentially all types of towers.

Remedial measures . . . For the existing cooling-tower system at Baytown, it is estimated that present rates of chemical deterioration can be reduced about 50 per cent by reducing alkalinity of circulating water to 7.0 pH and by using the minimum amount of chlorine. It is estimated that the rate of deterioration caused by organisms can be reduced 36 to 50 per cent by reducing the rate of chemical attack and by employing better sanitation practices. Reductions in the deterioration in this manner may not be directly applicable at other plants; directionally, they are sound, and should be given consideration in each case.

Technical Subcommittee III of the Cooling Tower Institute has unequivocally gone on record for improved cooling-tower sanitation.

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Controlling Wood-Destroying Fungi

Fungi require air, food, water, and a favorable temperature. Any measure which will cause any of these requirements to become unfavorable will reduce the rate of attack by fungi. The operation of circulating-water systems at 6.0 to 7.0 pH will reduce the rate of leaching of natural preservatives from new redwood, while at the same time it will not affect the rate of removal of soluble sugars, and it should result in satisfactory control in new towers of induced-draft counterflow design, particularly if hot-water temperature exceeds 120° F. The measures required to control fungi at existing towers not benefited by these limits to fungal activity are:

1. The use of treated wood for replacements, particularly in the mist eliminator sections.
2. The shock treatment of circulating water with toxic agents.
3. The operation of the older towers at maximum loading (gallons per minute per square foot) of cells in operation, as limited by cold-water temperature, so as to place drift-eliminator members under total immersion conditions.
4. The treatment with strong solutions of toxic agents (such as sodium pentachlorophenate by spray techniques) of cells temporarily out of operation because of (3 above), because of fan failures, or because of unscheduled unit down times.
5. The treatment of infected areas which can be dried during scheduled down times with oil solutions of preservatives such as copper naphthenate and pentachlorophenol.

Controlling Biological Fouling

The control of biological fouling by toxic sprays was investigated in the refinery between November 14 and December 14, 1951. Sodium pentachlorophenate appears promising from the standpoints of residual effectiveness and noncorrosiveness. Copper sulfate deserves additional study as an antiseptic. A limitation of the spray technique is accessibility to bottoms of slats. Control of fouling by spray techniques can be considered only in the sense that it augments chlorination of the circulating water.

Sodium pentachlorophenate and the copper salts are toxic to marine life. Amounts of these materials which can be tolerated in any effluent is of the order of 0.1 to 0.3 p.p.m. Therefore, application of these materials to combat fouling or fungi attack must be scheduled in such a manner that the allowable concentration in the effluent streams would not be exceeded.

If the makeup contains appreciable amounts of filterable solids, which contain organic material including cellulose - destroying fungi, as well as silt, the solids will accumulate in tower basins and in the open distribution pans of the cross-flow towers and will become septic.

The accessibility and flocculent character of the solids make removal by pumping or siphoning techniques very promising, particularly if basins are designed with this type of removal in mind.

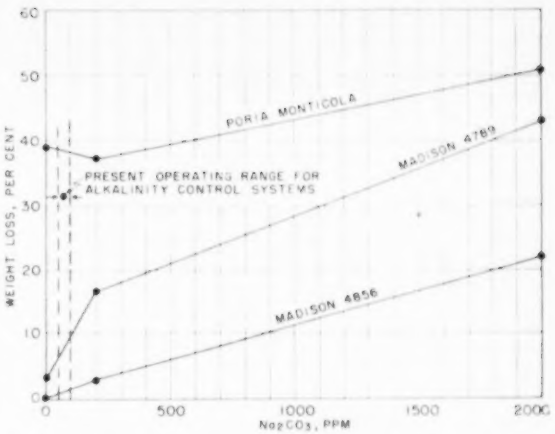

Fig. 1—Weight loss of specimens exposed 90 days to fungi after 1 day of leaching in aerated sodium carbonate under reflux conditions. (From data published by Forest Products Laboratory.)

For existing towers which can be taken out of service during scheduled process-unit down times, the mechanical cleaning of the basins appears promising. For example, the cost of cleaning the basin of a large tower at Baytown in 1951 was one-third the cost of the chlorine consumed at this unit during the year.

For existing towers whose basins cannot be drained for cleaning during unit down time, the only practical method of controlling suspended and deposited solids is sidestream filtration. It is possible that the designs of new basins can be modified to provide bottoms-sediment traps ahead of the cold-water flumes, and that the traps can be cleaned periodically by pumping out the sediment.

Currently, sanitation of circulating-water systems at Baytown is limited to continuous chlorination for the primary purposes of maintaining clean heat-transfer surfaces and clean water-distribution systems, physical cleaning of distribution systems and tower basins, and the use of spray techniques of antiseptic solutions on drift eliminators during the winter months.

Dilute Alkaline Solutions

Under a series of cooperative agreements with Marley Co., Inc., the Forest Products Laboratory of the U. S. Department of Agriculture undertook an investigation of the effect of dilute alkaline and chlorine solutions on the resistance to decay of redwood by brown-rot fungi which were known to attack soft woods and by unidentified species isolated from diseased towers.

The data indicated that alkalinity is a more serious factor than chlorination in the removal of natural preservatives from redwood. This might be expected, inasmuch as the preservatives are naturally acidic.

In Fig. 1 the losses for specimens leached 1 day in sodium carbonate solutions are plotted against concentration of leaching agent. It is indicated that, when specimens are leached 1 day in sodium-carbonate solutions un-

TABLE 1

Tower No.—	pH	Normal makeup, g.p.m.	Chlorine consumption, 1951 averages: Tons per month	Chlorine consumption, 1951 averages: Tons per month per 1,000 g.p.m. of makeup
17 to 25 and 26	8.0	1,800	4.46	2.6
9 to 13	8.8	1,000	2.64	2.6
11 to 15	8.7	650	2.91	4.5
12 to 35	8.4	750	2.88	4.0
8	8.6	650	0.91	*1.4
29	8.2	400	0.18	†0.5
¶37	8.7	375	2.77	‡7.4

*During March and April chlorine was added at the rate of 3½ tons per month per 1,000 g.p.m. of makeup, supposedly without exceeding 0.5 to 0.75 p.p.m. available chlorine. A residual has apparently not been maintained continuously. †On the basis of a maximum chlorine demand in 10 min. of 6 p.p.m. for makeup 400 g.p.m. would require 0.43 ton per month, or 1.15 tons per month per 1,000 g.p.m. Obviously, a residual is not maintained in this system continuously. ‡High consumption is attributed to high hot-water temperature and long retention in open condenser boxes and possibly to more rapid reaction with wood at the higher temperature. ¶Chlorination discontinued in August 1951, because of chlorine shortage; resumed in September 1952.

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This Chart shows the proper setting for constant load engines

BRAKE H. P. AT BELT	NAT. GAS CU. FT. PER HOUR	BUTANE GALLONS PER HOUR	GASOLINE GALLONS PER HOUR	M. M. OIL DROPS PER MIN.	M. M. OIL HOURS PER QUART
10	115.	1.07	1.12	4	228
15	172.5	1.60	1.68	6	152
20	230.	2.14	2.24	8	114
25	287.5	2.67	2.80	10	91
30	345.	3.21	3.36	12	76
35	402.5	3.74	3.92	14	65
40	460.	4.28	4.48	16	57
45	517.5	4.81	5.04	18	50
50	575.	5.35	5.60	20	45
60	690.	6.42	6.72	24	38
70	805.	7.49	7.84	28	32
80	920.	8.56	8.96	32	28
90	1035.	9.63	10.08	36	25
100	1150.	10.70	11.20	40	22
120	1380.	12.84	13.44	48	19
140	1610.	14.98	15.68	56	17
160	1840.	17.12	17.92	64	14
180	2070.	19.26	20.16	72	12
200	2300.	21.40	22.40	80	11
225	2587.5	24.00	25.20	90	10
250	2875.	26.75	28.00	100	9
275	3162.5	29.42	31.10	110	8
300	3450.	32.10	33.60	120	7

EXAMPLE:—If you use 805 cu. ft. of dry gas, 7.49 gallons of butane or 7.84 gallons of gasoline, your H.P. is about 70, so adjust oiler to feed 28 drops per minute. You will then receive about 32 hours per quart of MARVEL MYSTERY OIL.

If engine load increases after setting for normal load, oiler will automatically increase its feed, or decrease its feed when load is lessened.

When more than one oiler is used

To determine drop count per oiler when more than one oiler is used on an engine—divide recommended drop count by number of oilers.

NOTE: Guarantee on oiler is void if any other oil than MARVEL MYSTERY OIL is used therein. Some *engines* also carry this guarantee policy.

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der the severe laboratory conditions, the subsequent rate of deterioration is a function of the concentration of sodium carbonate in the leaching solution for the two fungi isolated from diseased wood. The Na_2CO_3 content of circulating waters in most systems at Baytown is of the order of 50 to 100 p.p.m., as indicated in Fig. 1. An obvious conclusion is that long exposure of redwood to moderate alkalinity in cooling towers decreases its resistance to wood-destroying organisms.

Chlorination of Cooling Towers

Theoretically, the amount of chlorine reacting with wood in a given time at a given temperature depends on the residual of available chlorine, the chloride-ion concentration, and the pH. If 1 lb. of chlorine oxidizes 5 lb. of lignin to the extent that it is soluble in slightly alkaline water, then for 1 lb. per day of chlorine consumed by lignin oxidation there would be a loss of 5,500 lb. of dry wood each year; this loss would manifest itself in reduced cross-sectional areas of wood members. In a system with a blowdown of 400 g.p.m., this wood loss would be equivalent to a lignin content of only 1 p.p.m. At this time it is not known what proportion of chlorine added to circulating-water systems reacts with the wood.

Annual consumption of chlorine in Baytown cooling towers which are hot normally contaminated by oil and sulfur compounds, and in which chlorine residuals can generally be maintained between 0.5 and 0.75 p.p.m., is given for 1951 in Table 1.

To maintain a chlorine residual in circulating water, it is necessary to add chlorine at a rate in excess of the sum of the following: (1) the rate of entry of inorganic and organic chlorine-demanding materials in the makeup and in the air; (2) the rate of formation of chlorine-demanding material from the fouling organisms and solids deposited in the basin and pans; (3) the rate at which chlorine is consumed in the oxidation of wood and metal components, and (4) the rate at which chlorine is lost to the air from purely physical factors. It is reasonable to assume that chlorine consumption is influenced primarily by Items (1) and (4).

It is interesting to consider the service obtained from the fill in each of the towers listed in Table 1. The maximum rate of loss of wood dimensions at Baytown has been noted at Tower 37. This rate (about 0.1 in. in 18 months while chlorine was injected) is attributed to a high reaction rate at the unusually high hot-water temperature (150° to 160° F.). Fill replacements have been necessary at Towers 8, 9, 11, 12, 13, 15, and 17 after 12, 14, 13, 11, 12, 8, and 11 years of service, respectively, or an average of 11.5 years. The fills in Towers 25, 26, and 35 have been appreciably attacked. The attack on the fill is not limited entirely to chemical attack, but chemical attack is believed to have predominated in all towers with the possible exception of Tower 15.

Rates of injection of chlorine to recirculating-water systems requires careful control if wood deterioration is to be minimized. It is possible that reduction of makeup through operation at lower pH and improved sanitation practices will result in shock chlorination's becoming more generally practical. This would minimize the chlorine-residual-time factor.

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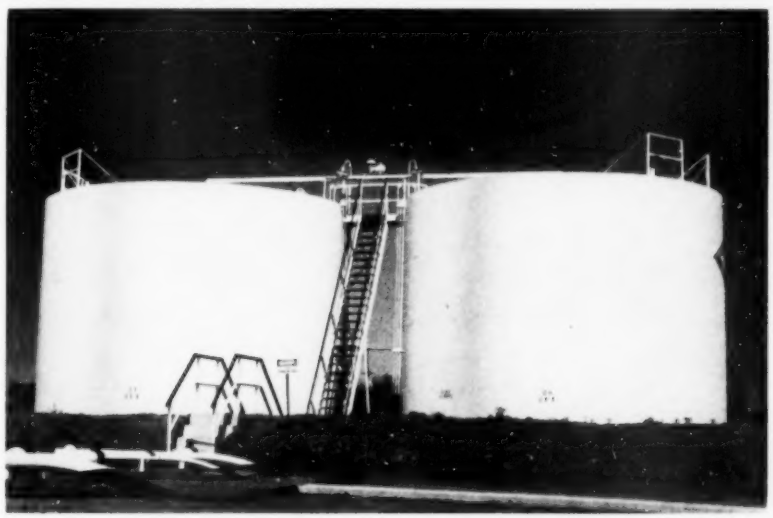

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by Dr. B. E. Lauer, Head, Department of Chemical Engineering, University of Colorado

h_f HEAT TRANSFER

COEFFICIENT of HEAT TRANSFER between SURFACE of VERTICAL TUBE and GRANULAR SOLID IN A FLUIDIZED BED

Direction of Heat Flow: Warm tube to cool bed

EQUATION:

$$h_f = 0.55 \frac{K_g}{D_t}\left[\frac{D_t}{L}\right]^{0.65}\left[\frac{D_t}{D_p}\right]^{0.17}\left[\frac{(1-\varepsilon)\rho_s C_s}{\varepsilon \rho_g C_g}\right]^{0.25}\left[\frac{D_t G}{\mu_g}\right]^{0.8}$$

or in somewhat simplified form

$$h_f = 0.5 \frac{K_g}{D_t}\left[\frac{D_t}{L}\right]^{0.65}\left[\frac{D_t}{D_p}\right]^{0.17}\left[\frac{\rho_s C_s}{\rho_g C_g}\right]^{0.25}\left[\frac{D_t G}{\mu_g}\right]^{0.8}$$

TERMINOLOGY:

h_f - Heat transfer coefficient (apparent) between tube wall and fluidized bed, BTU/hr.sq.ft.°F. $= q_w / A(t_w - t_c)$.
K - Thermal conductivity, BTU/hr.ft.°F.
D_t - Diameter of tube, ft.
D_p - Diameter of particle, ft.
ρ - Density, lbs./cu.ft. (apparent density of solids).
L - Depth of fluidized bed, ft.
C - Specific heat, BTU/lb. °F.
G - Mass velocity of arriving fluidizing gas, lb./hr. sq.ft. $= 4\,w_g/\pi D_t^2$
μ - Viscosity, lbs./ft.hr.
ε - Fraction of voids in fluidized bed. Dimensionless.
q - Heat transferred to fluidized bed, BTU/hr.
A - Area of tube wall in contact with fluidized bed, sq. ft.
t - Temperature, °F.
w - Mass rate of flow, lbs./hr.
Subscript
s - Relates to fluidized solid.
g - Relates to fluidizing gas.
w - Relates to wall of tube.
c - Relates to center of fluidized bed.

LIMITATIONS:

Determinations made under following conditions:
1. Heat transferred to bed. Would probably be satisfactory for reverse.
2. Particle size 37 to 350 μ(aver.).
3. True solid density, 184 to 466 lb./cu.ft.

PHYSICAL CONSTANTS:

For physical constants for use in above equation see Chemical Engineers' Handbook - J. H. Perry (1940).

for K - 400-401, 1908, 1909.
ρ - 130-140, 1781-1782, 1783.
C - 1928-1930, 1937, 1938, 1939.
μ - 370-374, 1190, 1896.

REFERENCES:

1. W. H. Hoy and Max Jakob, Chem. Engr. Prog. 47, 637 (1951).

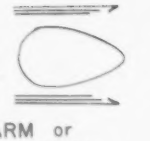
Q 1 4 c (2)

COEFFICIENT of HEAT TRANSFER through FILM between STREAMLINE SHAPES and a FLUID

Fluid Movement: Streamline Flow

Direction of Fluid: Normal to tube

Direction of Heat Flow: Heating or Cooling



EQUATION:

$$h_f = \frac{K}{De}\left[0.35 + 0.47\left[\frac{De V \rho}{\mu}\right]^{0.52}\right]\left[\frac{C\mu}{K}\right]^{0.3}$$

TERMINOLOGY:

h_f - Film coefficient of heat transfer, BTU/hr. sq. ft. °F.
K - Thermal conductivity of fluid at t_f, BTU/hr. sq. ft. °F./ft.
De - Total perimeter/π, ft.
V - Velocity through minimum free area, ft./hr.
ρ - Density of fluid at t_f, lb./cu. ft.
μ - Viscosity of fluid at t_f, lb./ft. hr.
C - Specific heat at constant pressure, BTU/hr. °F.
t_f - Average film temperature, °F, $t_f = 0.5\,(t_s + t)$.

LIMITATIONS:

Determined for air over heated surfaces. Probably satisfactory for other uses.

Reynolds number ($DeV\rho/\mu$) must be between 0.1 and 1000.

If used for liquids ($C\mu/K$) must be between 6 and 1940.

PHYSICAL CONSTANTS:

The values of the physical constants such as density, viscosity and others are reported in the International Critical Tables, in several handbooks, and in the technical literature.

Page references in the Chemical Engineers' Handbook, J. H. Perry (1940) are as follows:

for ρ - 130-140, 1781-1782, 1783.
μ - 370-374, 1190, 1896.
K - 400-401, 1907, 1908.
C - 1928-1930, 1937, 1938, 1939.

REFERENCES:

1. Heat Transmission, William H. McAdams, p. 227.
2. Hughes, J. A., Phil. Mag., Series 6, 31, 118 (1916).

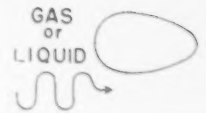
R 1,2,4,5 b

COEFFICIENT of HEAT TRANSFER through FILM between STREAMLINE SHAPES and a FLUID

Fluid Movement: Turbulent

Direction of Fluid: Normal to tube

Direction of Heat: Heating or cooling



EQUATION:

$$h_f = 0.26 \frac{K}{De}\left[\frac{De V \rho}{\mu}\right]^{0.6}\left[\frac{C\mu}{K}\right]^{0.3}$$

TERMINOLOGY:

h_f - Film coefficient of heat transfer, BTU/hr. sq. ft. °F.
K - Thermal conductivity of fluid at t_f, BTU/hr. sq. ft. °F./ft.
De - Total perimeter/π, ft.
V - Velocity through minimum free area, ft./hr.
ρ - Density of fluid at t_f, lb./cu. ft.
μ - Viscosity of fluid at t_f, lb./ft. hr.
C - Specific heat at constant pressure, BTU/hr. °F.
t_f - Average film temperature, °F, $t_f = 0.5\,(t_s + t)$.

LIMITATIONS:

Reynolds number from 1000 to 500,000.
Accuracy 20% . Developed for air over heated shape. Probably satisfactory for others.

EQUIVALENT EQUATION: air or dilute gases.

$$h = 0.4\,\frac{V}{D_e}\left[\frac{De V \rho}{\mu}\right]^{0.6}$$

PHYSICAL DATA:

For Reynolds numbers above 10,000, h_f is approximately 5% or more below if fluid approaches stagnation or creep.

PHYSICAL CONSTANTS: For physical constants for use with a variation see Chemical Engineers' Handbook - J. H. Perry (1940).

for ρ - Isometric, 130-140, 1781.
μ - 370-374, 1190, 1896.
K - 400-401, 1907, 1908.
C - 1928-1930, 1937, 1938, 1939.

REFERENCES:

1. Heat Transmission, William H. McAdams, p. 227.
2. Hughes, J. A., Phil. Mag., Series 6, 31, 118 (1916).

R 1,2,4,5 c

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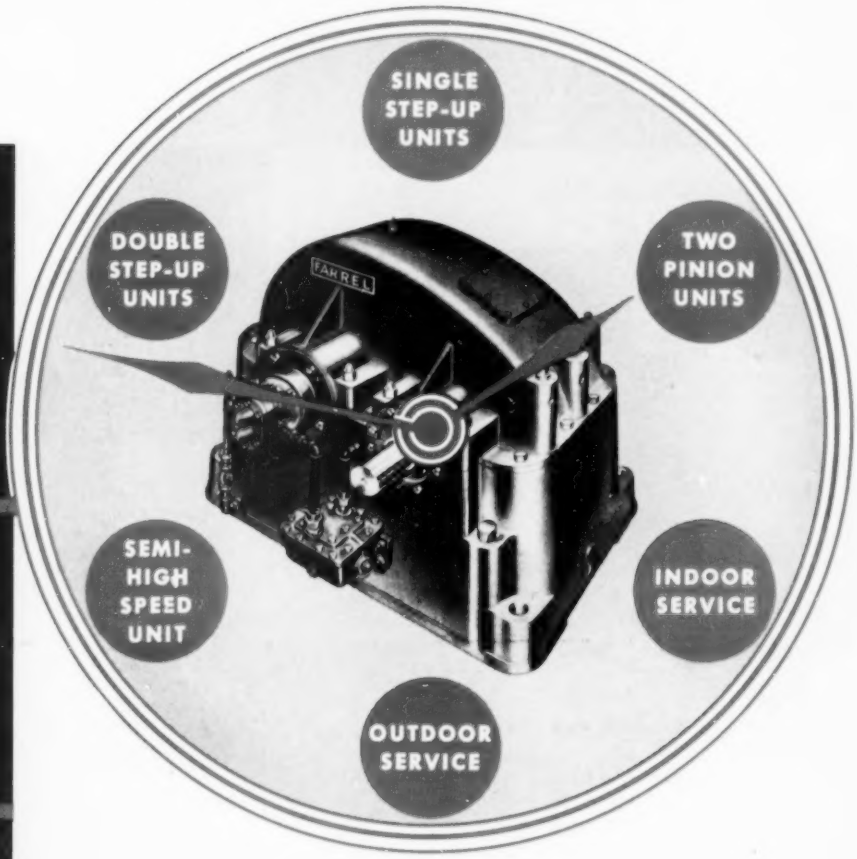

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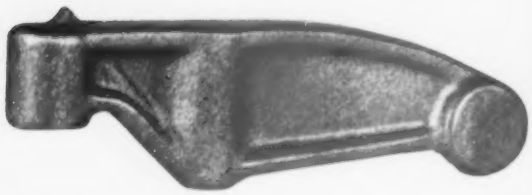

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BETHLEHEM STEEL

by W. L. Nelson
Technical Editor

QUESTIONS ON TECHNOLOGY

Pipe-Line Transportation Rates

"We notice a great difference in pipe-line charges. Why is there such a big variation?"—F.L.J.

Average pipe-line rates, according to the Interstate Commerce Commission, are now about 0.065 cents per barrel-mile:

	Approx. ct./bbl.-mile in trunk lines	Index based on 1946
1943	0.0608	101
1944	0.0610	101
1945	0.0615	102
1946	0.0601	100
1947	0.0605	101
1948	0.063	103
1949	0.064	107

These charges include earned surplus and other miscellaneous appropriations amounting to at least 8-10 per cent. These averages check reasonably well with the specific rates listed in Table 1.

Probably the most important factor in causing large variations in pipe-line rates is the capacity at which a line operates. For example, when a 3,200-bbl. per hour line (18-in.) is operating at 500 bbl. per hour, the cost of operation is about four times (400 per cent) larger. This is illustrated by the data of Fritz Karge[5] shown in Table 2.

In addition to the very important factor of "loading," the cost of transportation in very large lines is relatively low and long-distance transfers are relatively cheap. Table 1 does not seem to substantiate the statement that long-distance hauls are cheaper but in reality many of the apparently long-distance shipments of Table 1 consist of transfers through a series of short-distance lines. Rates in one products line indicate the following relationship of distance of transport, to cost:

Miles	Cents per bbl.-mile
200	0.107
400	0.097
600	0.089
1,000	0.081

Finally, competition with other means of transport is an important factor in forcing a pipe line to operate efficiently and cheaply. Thus, in an old established, large-diameter, long-distance, and highly competitive system, the pipe-line rate may be less than 0.04 (or even 0.025) cents per barrel-mile, whereas in a heavily investment-laden system, the rate may be as high as 0.10 cents per barrel-mile.

According to the annual report of the Oil and Gas Division of Texas for 1951, the rates of transportation to all Gulf Coast destinations were:

From—	Cents per bbl.
Panhandle	22½
West Texas	20
West Central Texas	17½
East Texas	10-12½
East Central Texas	10
Southwest Texas	5-10
Texas Gulf Coast	5-7½

TABLE 2—EFFECT OF LINE SIZE ON CAPACITY ON DIRECT PIPE-LINE TRANSPORTATION COSTS[3] (1930)

Bbl. per hr.	Cost—cents per barrel-mile					
	8-in.	10-in.	12-in.	14-in.	16-in.	18-in.
500	0.023	0.023	0.026	0.029	0.033	0.039
1,000	0.025					
1,250	0.032	0.016				
1,500			0.013			
1,750				0.011	0.011	
2,000		0.024				
2,550						0.0098
2,750			0.018			
3,250				0.015	0.011	
3,750						0.0093
4,500					0.014	0.010

References

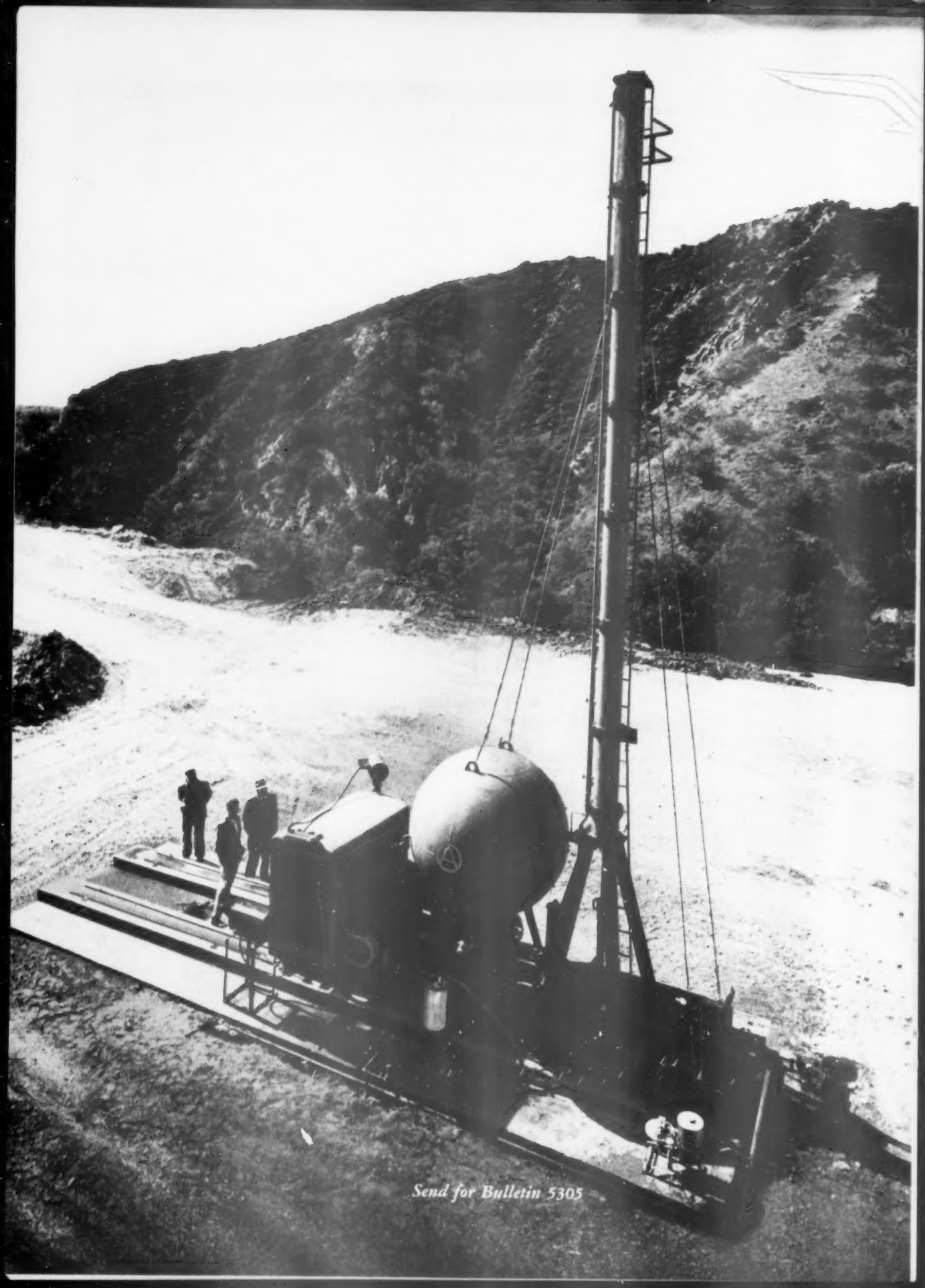
1. Humble Pipe Line Co., Pipe-Line Rates I.C.C. 24 and Reissues.
2. Petroleum Data Book, p. H-23, Petroleum Eng. Publ. Co., 1948.
3. Private communication.
4. Natl. Pet. News, Jan. 9, 1946, p. 18.
5. Karge, F., A.S.M.E. meeting, Tulsa, Oct. 6, 1930.

Table 1—Approximate Miscellaneous Trunk Pipe-Line Rates—Cents Per Barrel Mile

(References 1-4)

	Approx. miles*	Rate: Cents per bbl.-mile	Rate: Total	Year
From Borger, Tex., to:				
Wichita	325	0.089	29	1948
Kansas City	535	0.062	33	1948
Des Moines	741	0.055	41	1948
Omaha	744	0.063	47	1948
St. Louis	790	0.067	53	1948
Minneapolis	997	0.063	63	1948
Alexandria, Minn.	1,115	0.0637	71	1948
From Tulsa to:				
Kansas City	250	0.112	28	1948
Des Moines	456	0.079	36	1948
Minneapolis	712	0.0813	58	1948
Chicago	724	0.08	58	1948
From K. C., Kans., to:				
St. Louis	255	0.125	32	1948
From East Texas to:				
Texas City	200	0.044	8.7	1948
Port Arthur	210	0.048	10	1948
Baton Rouge	240	0.042	10	1948
St. Louis	512	0.055	28	1948
Chicago	770	0.047	36	1948
Findlay, Ohio	865	0.051	44	1948
Toledo	895	0.047	42	1948
Detroit	960	0.048	46	1948
Cleveland	975	0.053	51	1948
Buffalo	1,130	0.0505	57	1948
New York (Big Inch)	1,350	0.012-0.016	17-22	†1946
From West Texas to:				
Big Spring, Tex.	44	0.137	6	1948
Texas City, Tex.	440	0.043	19	1948
Beaumont, Tex.	480	0.043	19	1948
Cushing, Okla.	420	0.048	20	1948
St. Louis	820	0.041	33	1948
Detroit	1,290	0.040	52	1948
From Casper, Wyo., to:				
St. Louis	880	0.042	37	1948
Chicago	945	0.042	40	1948
Detroit	1,250	0.045	57	1948
From Winkler, Tex., to:				
Baytown, Tex.	440	0.091	40	1931
Baytown, Tex.	440	0.074	32.5	1933
Baytown, Tex.	440	0.062	27.5	1934
Baytown, Tex.	440	0.057	25	1938
Baytown, Tex.	440	0.051	22.5	1941
Baytown, Tex.	440	0.045	20	1950
From Ardmore, Okla., to:				
Coffeyville, Kans.	239	0.134	32	1953
Kansas City	393	0.100	39	1953
From K. C., Kans., to:				
Des Moines	196	0.107	21	1953
Minneapolis	462	0.096	43	1953
Alexandria, Minn.	580	0.088	51	1953
Grand Forks, N. D.	806	0.083	67	1953

*Estimated by an inspection of maps. †Computations.[4]


Send for Bulletin 5305

Smooth, steady **loading**

makes the big difference in sucker rod life with the NEW AXELSON Hydraulic Long Stroke Unit

To accomplish a 25′ stroke, up and down, several times a minute results in dynamic loading of any pumping unit, regardless of type or make. It is not only important to minimize these loads, but also to damp them out promptly and obtain a smooth steady stroke during as much of the polished rod travel as possible.

The Axelson centrifugal pump which motivates our hydraulic system is specially designed and built to obtain the maximum of smooth action. This type pump (simulating the action of a fluid coupling) assures, to the greatest degree, a smooth steady stroke of the rod string, thereby eliminating much of the dynamic loading, and extending sucker rod life.

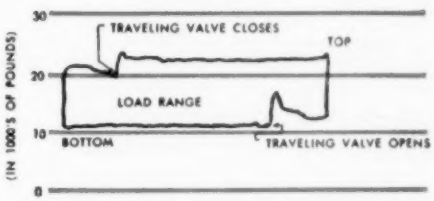
The Axelson Hydraulic Long Stroke Pumping Unit has 30,000* lb. load capacity and up to 350′ polished rod velocity.

Available in:

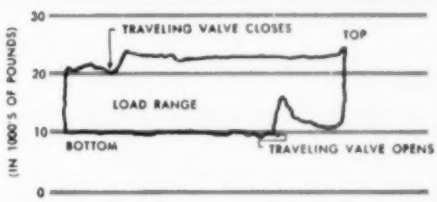
Model H-0312 — STANDARD DUTY — for well applications requiring 69 or less Engine Brake Horse Power.

Model H-0313 — HEAVY DUTY — for well applications requiring 70 or more Engine Brake Horse Power.

** Operation of Unit limited to either 30,000 lbs. polished rod load capacity or 14,000 load range.*



Card Area . . . 2.97 sq. in. • Stroke Length . . . 300 in.
Cycles per minute . . . 3.91 • Well Depth . . . 6,600 ft.
Pump Bore . . . 2 in. • Polished Rod HP . . . . 32.05 HP
Engine HP . . . 56.0 HP • Unit Efficiency . . . 57.4 per cent



Card Area . . . 3.52 sq. in. • Stroke Length . . . 314 in.
Cycles per minute . . . 4.9 • Well depth . . . 6,600 ft.
Pump Bore . . . 2 in. • Polished Rod HP . . . 48.0 HP
Engine HP . . . 88.5 HP • Unit Efficiency . . 54.1 per cent

Two typical dynagraph cards taken with an Axelson 25′ stroke unit on a 6,600 ft. well producing about 500 bbl. per day with a two inch bore pump. The rectangular-shaped card, with a comparative small deviation from the steady upstroke and downstroke horizontal line, helps to explain the exceptional sucker rod service obtainable. Although an actual picture of pressure changes in the cylinder below the piston, these cards give a very close indication of polished rod loads in the cycle.

AXELSON MANUFACTURING COMPANY . . . *Chosen first . . . to Last!*

PETROLEUM PUMPING EQUIPMENT

Division of Pressed Steel Car Company, Inc.
6160 South Boyle Avenue • Los Angeles 58
PLANTS: Los Angeles 58 • St. Louis 16
OFFICES: New York City 7 • Tulsa 1

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

REPRESENTATIVES IN ALL PRINCIPAL OIL FIELDS

LS-11

DURABLA

METAL PUMP VALVE UNITS ARE USED ON ALL TYPES OF RECIPROCATING PUMPS IN OVER 500 APPLICATIONS

- **METALLURGICAL INDUSTRIES**
  - Mining
  - Steel Plants
  - Refineries
- **RAILROADS**
  - Shops and Roundhouses
  - Water Service
  - Locomotive Feed Water Service
- **PROCESSING INDUSTRIES**
  - Chemical Plants
  - Soap Manufacture
- **STEAM POWER PLANTS**
  - Central Stations
  - Industrial
- **CONSTRUCTION**
- **ROAD BUILDING**
- **WATER WORKS**
- **GAS PLANTS**
- **PETROLEUM INDUSTRY**
  - Oil Field Service
  - Oil Pipe Lines
  - Oil Refineries
- **MARINE**
  - Shipboard Service
  - Cargo Transfer
  - Shipyards and Drydocks
- **DIESEL POWER PLANTS**
  - Public Utility
  - Industrial

Wherever reciprocating pumps are used, and the above chart is merely an outline of some of the principal fields of application, DURABLA METAL PUMP VALVE UNITS* will be found in service, sometimes as standard equipment supplied by the pump manufacturer, sometimes as replacement units on a wide variety of pumps. To assist in ordering and stock keeping there are eleven standard sizes of DURABLA Pump Valve Units, designed to meet over 300 variations in installation requirements. In virtually every conceivable pump application; under extremes of high or low temperature; with highly corrosive fluids; in any position; and in service where long-term freedom from routine inspection and replacement is necessary, DURABLA Pump Valve Units are available to meet your needs.

Write DURABLA Engineering Department for information and Bulletin, Reference 009

* Patent Numbers 2090486, 2117504

DURABLA MANUFACTURING COMPANY
114 LIBERTY ST. NEW YORK
BRANCHES IN PRINCIPAL CITIES. FOR CANADA REFER: CANADIAN DURABLA LIMITED, TORONTO

EQUIPMENT MEN . . . in the News

Elliott Co. Announces Executive Appointments

H. S. PAHREN

Elliott Co., of Jeanette, Pa., has announced the appointment of H. S. Pahren, W. E. Widau, and J. H. Strickler as commercial vice presidents.

Pahren joined Elliott Co. in 1924, following his service with Union Gas & Electric Co. and Westinghouse. After a training course, he was assigned to the Kansas City office, then was located in Omaha for 5 years. He was Tulsa manager for several years, and St. Louis office manager for 5 years. In 1946 he became New York district manager.

W. E. WIDAU

J. H. STRICKLER

Widau came to Elliott Co. in 1920. His first assignment with the company was as field engineer in the Cleveland office, later returning to Jeannette as assistant manager and then manager of the condenser department. In 1928 he became district manager of the Kansas City office. In 1936 he was appointed midwestern manager of the company, and since 1941 he has been Chicago district manager as well as mid-western manager.

Strickler joined the company upon graduation as a mechanical engineer from Penn State. After completing sales apprentice course, he was assigned as a field engineer in the Pittsburgh office in 1923, and he has been manager of that office since 1931.

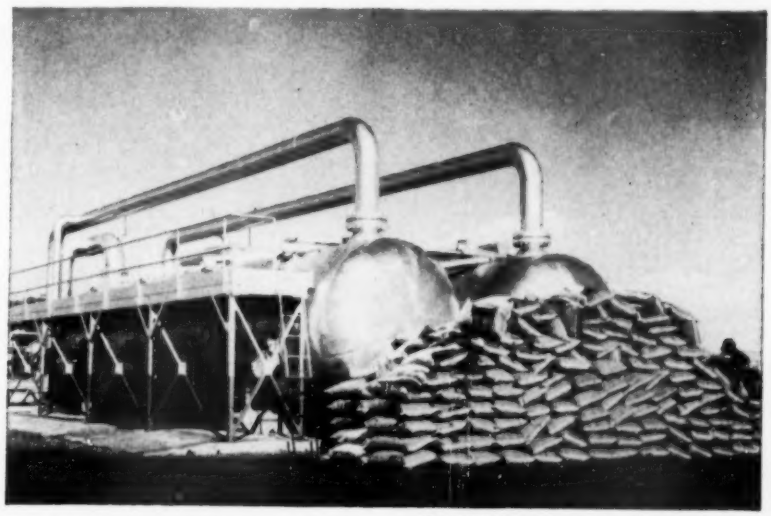
Trusler, Maddox Named to Protective Coatings Posts

Appointments of H. F. Trusler, Jr., and M. E. Maddox to sales positions in New York City and Atlanta, respectively, have been announced by N. T. Shideler, manager of the Protective Coatings Division, Pittsburgh Coke & Chemical Co., Pittsburgh.

Trusler has been assigned to the East Coast sales area and is now located in the New York City office of the company. Maddox, formerly in the division's Tulsa office, has been transferred to the southeastern area and will headquarter in Atlanta.

Carlon Corp. Opens Plant In Klamath Falls, Ore.

Carlon Products Corp. has announced the establishment of facilities for the manufacture of plastic pipe and fittings in the Far West. The new plant is situated in Klamath Falls, Ore., and will be utilized to alleviate distribution problems for Carlon plastic pipe. The facilities of the new plant will provide rapid and economical de-



Gas dehydration units, San Juan Basin Plant

THE WORLD'S LARGEST
HORIZONTAL GAS DEHYDRATION UNIT OF

El Paso Natural Gas Co.

***Uses* FLORITE**

Most economical of the granular drying agents, Florite has a longer service life, gives a low dew point depression, and aggressively resists "poisoning effects" which permanently destroy adsorption qualities.

Natural gas, propane, butane, gasoline, air, nitrogen, carbon dioxide, refrigeration compounds—and a growing list of liquid and gaseous compounds—are successfully treated with superior drying efficiency by use of FLORITE DESICCANT.

Let us prove that Florite is best suited for your desiccant requirements, too.

FLORIDIN COMPANY ADSORBENTS DESICCANTS DILUENTS

Department C 220 LIBERTY STREET WARREN, PA.

"Measured by the ton mile, Hercules Red-Strand preformed outlasts others about two to one," reports one operations manager. Another operator testifies, "Our records show Red-Strand is considerably out in front of four other ropes."

Why HERCULES Red-Strand excels

What's the reason for such performance and praise? In simple terms, it's because *higher-than-rated quality* in Red-Strand preformed delivers *longer-than-expected service.*

If you're not completely satisfied with *your* wire rope service, try Red-Strand preformed. You'll experience the difference too.

Be sure to get your free copy of valuable 64-page LESCHEN Wire Rope Handbook. Ask your nearby HERCULES® Red-Strand distributor... or write direct.

Distributors in all principal cities

LESCHEN
WIRE ROPE AND SLINGS

LESCHEN WIRE ROPE DIVISION • ST. LOUIS 12, MISSOURI
The Watson-Stillman Company
(A SUBSIDIARY OF H. K. PORTER COMPANY, INC.)

livery of Carlon pipe to the distributors throughout the Northwest.

Philip Britton, vice president and spokesman for Carlon, announced the appointment of Floyd Wilson to managership of the new Carlon division.

The Klamath Falls plant brings to seven the number of plants Carlon has established throughout the United States. Another Carlon plant in Acton, Ont., supplies the Canadian market.

Sheppard is Appointed Gulf Coast Manager

Cherokee Laboratories, Inc., of Tulsa, has announced the appointment of Charles Sheppard, Jr., as area manager of the Gulf Coast with headquarters at New Orleans.

Previous to his joining Cherokee, Sheppard was associated with Gulf Oil Corp. as petroleum engineer, working with drilling muds. His association with the oil industry dates back to 1949 when he joined Gulf as a roughneck in a drilling crew.

Continental Sales, Inc., To Distribute SHMCO Products

Glenn Blackmann, S. I. (Sam) Pattillo, and Thad L. Putnam have announced the organization of Continental Sales, Inc., for the purpose of

G. BLACKMANN

S. I. PATTILLO

handling distribution of products manufactured by SHMCO Valves, Inc., of South Houston.

The manufacturing firm, formerly known as South Houston Machine Works, Inc., manufactures nonslam and conventional pipe-line check valves and other products for the drilling, production, and pipe-line industries.

Pattillo has been named sales manager of Continental Sales, Inc., and will devote much of his time to the establishment and supervision of a staff of manufacturer's representatives, who will provide direct representation in the active oil areas of the United States.

Blackmann has been manager of

*Only Carlon**

FOR SALT WATER DISPOSAL

Only CARLON Plastic Pipe effectively resists corrosion from salt water and other corrosive wastes. It is completely impervious to the effects of sulphurous waters, alkalies, sour crude and hydrochloric acid used to acidize disposal formations. Guaranteed forever against rot, rust and electrolytic action, CARLON Plastic Pipe successfully serves installations where ordinary metal pipe is continually replaced.

Extremely lightweight (only ⅛th as heavy as steel), CARLON can be installed in less time and with less effort. It is supplied in long lengths which require fewer fittings per installation. Permanent, leakproof connections can be made to existing metallic lines by means of plastic fittings and without special tools.

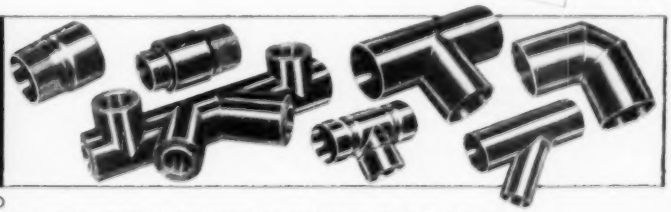
For economical salt water disposal piping that *lasts . . .*
specify CARLON Plastic Pipe. *Write today for literature.*

* The First REAL PIPE that is Plastic! • BUY THE PIPE WITH THE STRIPE!

1096 CP

CARLON PRODUCTS CORPORATION

Pioneers in Plastic Pipe

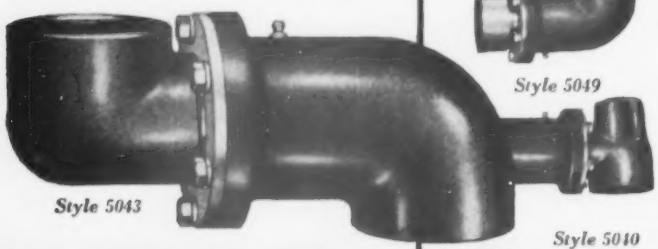


10201 MEECH AVENUE • CLEVELAND 5, OHIO

CARLON plastic pipe is produced in Texas, Colorado, Ohio, Oregon, North Carolina and Acton, Ontario, Canada.

BARCO

SWING JOINTS



FOR LOADING AND UNLOADING LINES

BARCO'S new, attractively priced, all-steel ball bearing *Swing Joints* are designed specifically for refinery *service* on loading or unloading lines handling gasoline, oil, lube oil, LP gas, petro-chemicals, and other fluids.

MANY STYLES—The Barco line is complete with single swing, double swing, and counterbalance styles to meet every need! Sizes 2", 2½", 3", 4".

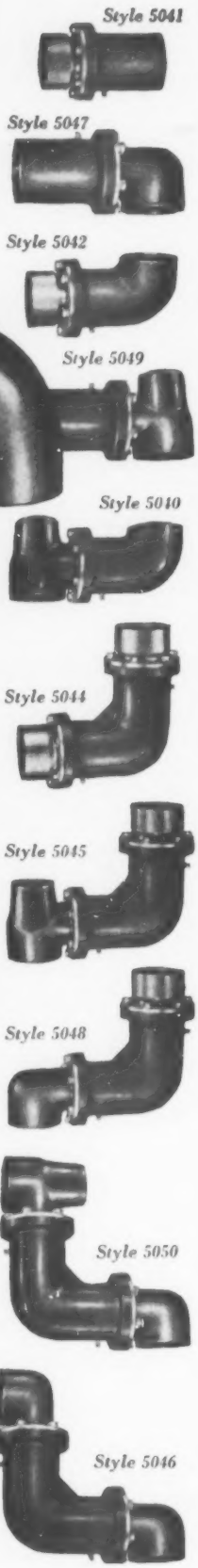
BALL BEARING AND O-RING EQUIPPED—In Barco Swing Joints, the ball bearings do not fall out when joints are taken apart! Long bearing provides adequate pipe support. *Special O-ring seal eliminates frequent gasket replacement and insures leakproof service* over wide temperature range, −40° F. to +225° F.

SIMPLE CONSTRUCTION—Joints can be disassembled for inspection without disconnecting piping. O-rings are easily renewable in the field.

ENGINEERING RECOMMENDATION—Barco will be glad to give you detailed recommendations on joints to use and suggested arrangements for complete loading and unloading assemblies.

Send for a copy of new Catalog No. 400 containing complete information on Barco Swing Joints. BARCO MANUFACTURING CO., 539K Hough St., Barrington, Ill.
(A Chicago Suburb)

BARCO—The Only Truly Complete Line of Flexible Ball, Swivel, Swing, and Revolving Joints



SHMCO Valves, Inc., for the past 5 years and will continue in this activity, along with assisting in the direction of Continental Sales, Inc.

Representation of SHMCO products in Mexico will continue to be handled by Jesus de la Garza, of Mexico City. Other export sales will be handled by Putnam, who operates Export Tool Co., of New York City.

Welex Promotes Vaughan To Vice Presidency

J. B. VAUGHAN

R. O. Shaffer, president of Welex Jet Services, Inc., has recently announced the promotion of Jack B. Vaughan as vice president in charge of sales and operations.

Vaughan became associated with Welex in 1952 in the capacity of general sales manager. He has been associated with both service and drilling companies throughout the Southwest for a number of years prior to his affiliation with Welex.

Graver Tank Opens New Sales-Engineering Office

H. L. O'BRIEN

W. M. Broxham, vice president for sales of the Graver Tank & Manufacturing Co., Inc., East Chicago, Ind., has announced the opening of a sales-engineering office in Los Angeles.

The Los Angeles office will be under the direction of William T. Hudson, manager of the new Graver plant at Casper, Wyo. District sales manager for the new office will be Hubbert L. O'Brien.

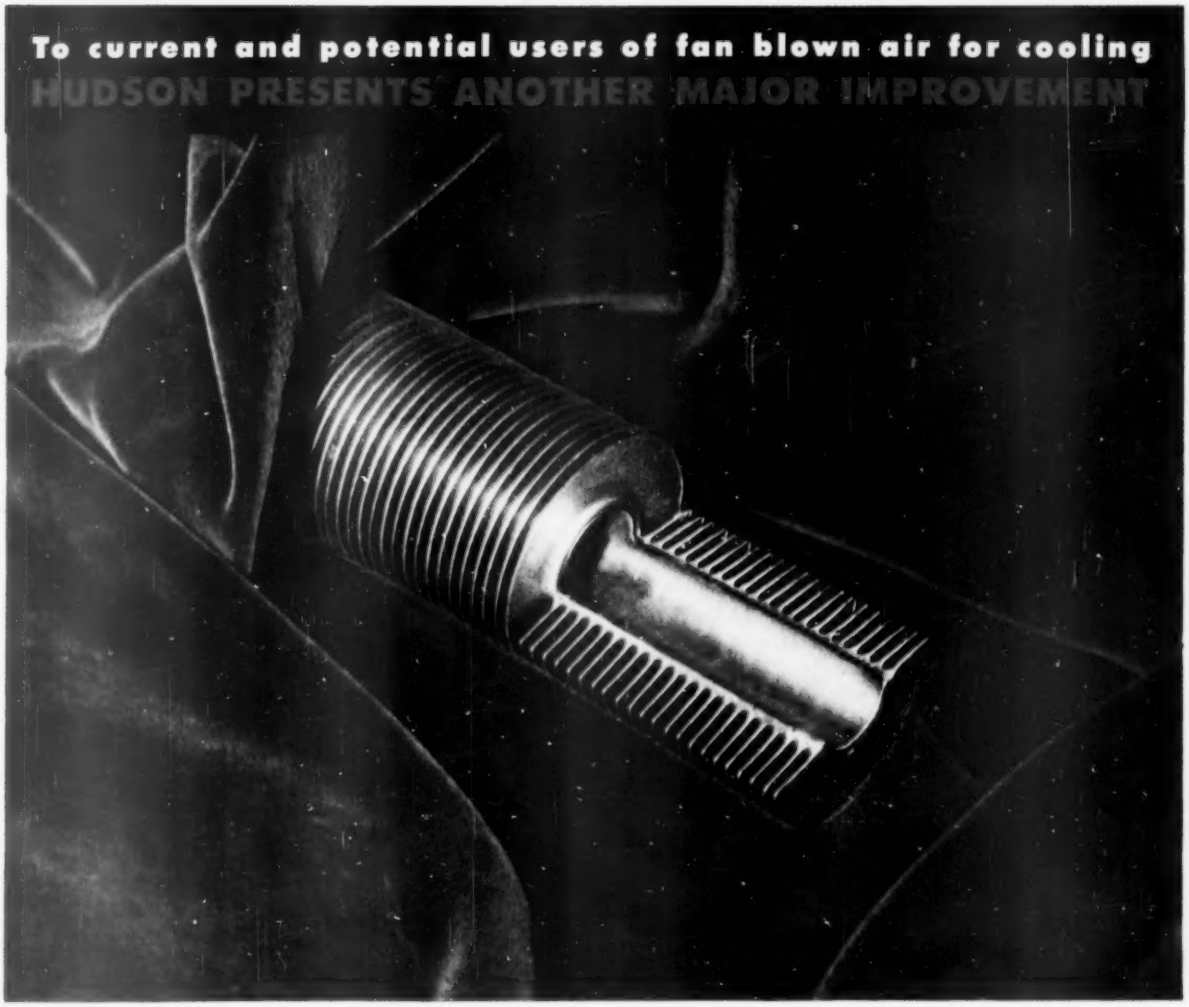
Robison Is Promoted to Machinery Division Head

The Dingle-Clark Co., contracting engineers of Cleveland, district representative of The Cleveland Worm & Gear Co. and The Farval Corp., recently announced the transfer of R. V. Robison to Cleveland, where he will manage the machinery division of the Cleveland territory. Replacing Robison in the Pittsburgh office will be L. B. Abrams, Jr., who will handle machinery sales in the Pittsburgh district.

Prior to joining the Pittsburgh office

To current and potential users of fan blown air for cooling

HUDSON PRESENTS ANOTHER MAJOR IMPROVEMENT



the NEW HUDSON HY-FIN DOUBLE TUBE

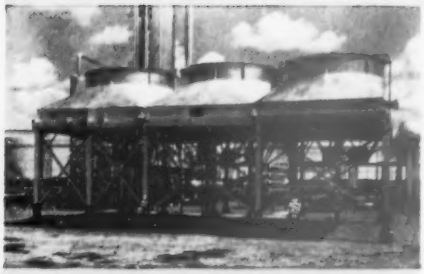
Now employed in HUDSON SOLO-AIRE and HUDSON COMBIN-AIRE units

The HUDSON HY-FIN is made possible through the development at HUDSON'S Houston plant of a special machine to form by cold extrusion from the metal of the tube itself closely spaced, uniform, extremely **high** fins, with integral surfaces of tube and extruded fins being smooth and streamlined.

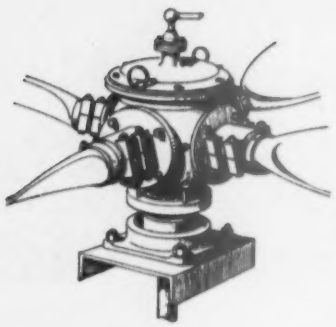
The finned outer tube is usually aluminum alloy, the inner tube may be admiralty, copper, steel, or alloyed steel. The two concentric, snugly fitted tubes with solid mandrel inside the inner tube are fed to the HUDSON HY-FIN machine where tremendous pressures serve to simultaneously extrude most of the metal of the outside tube into high fins, and to form a complete bond between the two tubes.

ADVANTAGES . . . See reverse side

No other hot fluid to air exchanger has all of the following advantages of HUDSON Solo-aire units using HUDSON HY-FIN DOUBLE TUBE



***SOLO-AIRE** — in which air alone is used for cooling.*



***AUTO-VARIABLE FAN** — automatic variation in fan pitch gives perfect control of cooled fluid temperature and saves horsepower.*

***COMBIN-AIRE** — in which air and water in combination are used for cooling.*

1. VERY HIGH HEAT TRANSFER PER LINEAL FOOT OF TUBING. The height of the fins, their extrusion from the tube itself (no crimping or welding), and the perfect bond between tubes, are the reasons.
2. LOW AIR HORSEPOWER REQUIREMENTS. The higher heat transfer rates allow the use of greater spreads between inlet and outlet air temperatures; hence less air mass is moved and less pressure drop encountered for a given heat removal.
3. RUGGED, DURABLE FINS. The strong, integral, smooth fins allow ease in cleaning, and are not susceptible to damage in transit, cleaning, or in operation.
4. ADAPTABILITY. The inner tube may be selected from a variety of materials to best resist corrosion or withstand temperature of the hot fluid. The outer finned tube is resistant to salt air and other atmospheric corrosion, and completely protects the inner tube from such corrosion. HUDSON HY-FIN tubes are in use in oil refinery services cooling corrosive hot fluids at temperatures above 650 F.
5. UNDIVIDED RESPONSIBILITY. The HUDSON HY-FIN assembly is manufactured from bare tubes by HUDSON and each tube and each step in the manufacture is subjected to rigid inspection to eliminate hidden defects.

The HY-FIN tube is another in the long list of improvements that have resulted from the constant effort to maintain and advance the quality and utility of HUDSON equipment.

HUDSON HY-FIN tubes are manufactured under one or more of three United States Patents. Other patents are pending.

HY-FIN, SOLO-AIRE and COMBIN-AIRE are registered trademarks.

HUDSON
ENGINEERING CORPORATION
FAIRVIEW STATION • HOUSTON, TEXAS

of Dingle-Clark in 1944, Robison spent 2 years as a sales correspondent for The Cleveland Worm & Gear Co., where he also completed his sales engineering training.

Abrams was formerly with Ingersoll-Rand Co.'s office, where he specialized in the sales of centrifugal pumps, steam condensers, and air ejector equipment. He served in this capacity until July 1 of this year, when he joined the Pittsburgh office of Dingle-Clark.

Aero Service Establishes Mid-Continent Offices

Establishment of Aero Service Corp. (Mid-Continent) at Tulsa was announced recently by Aero Service Corp., Philadelphia, the parent company. The new organization, formerly Frost Airborne Surveys Corp., will offer a greatly expanded aerial exploration and mapping service in the central United States. In addition to airborne mangetometer surveys for oil and minerals, Aero (Mid-Continent) will perform photogeologic studies, photo mapping, topographic mapping, and other geophysical and photogrammetric services.

Personnel of the Frost organization has been retained in the new company. J. C. Rollins will head the sales department, and Al Ibach will be in charge of production. C. H. Frost will be available as a consultant to the new firm. William B. Agocs, formerly head of the department of geophysics of University of Tulsa, and presently chief geophysicist for the parent firm, will be available as consultant in geophysical matters for the firm's clients.

Aero Service Corp. (Mid-Continent) is now part of the Aero complex of aerial mapping companies, a worldwide aerial mapping and exploration group.

Vaughn & Taylor Moves General Headquarters

Vaughn & Taylor Construction Co., Inc., pipe-line contractors, formerly of Wichita Falls, has announced the removal of its general headquarters to 2103 North Grant, Odessa, Tex.

Lummus Co. Adds Drummond To Sales Engineering

The Lummus Co., engineers and constructors, New York City, has announced that Virgil D. Drummond has joined the company in the capacity of assistant to Dr. E. R. Smoley, vice president, and will be engaged in sales engineering work.

AN EASY WAY TO RESCUE EQUIPMENT WEIGHING 44 TONS

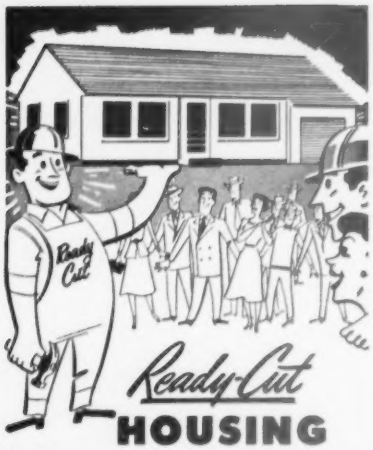
THE WISE CONTRACTOR is prepared for emergencies. The River Construction Company, laying pipe across the Trinity River, faced an emergency when a speeder LS 85 dragline slipped into 58 feet of water. This equipment was valuable and urgently needed on the job. The problem was to get it out and get it quickly. Let Mr. B. C. Hall, spread superintendent, tell how he rescued this heavy piece of machinery: "The only solution was to hook up two cables from two Carco winches and lift the speeder out. Those two Carco winches brought out that 44-ton dragline like it was a pail of water from a well. On pipeline work, the Carco winch can't be beat for efficiency, pulling power and long life."

Rescue work is only one of the many uses of a Carco winch. You'll find them valuable, too, in pulling or lifting pipe, in towing heavy equipment, in loading or unloading cars, in a variety of jobs on pipeline and heavy construction work.

Remember, you can expect greater value from the leading producer, and get it from Carco, first in winch production. PACIFIC CAR AND FOUNDRY COMPANY, Renton, Washington. Branches at Portland, Oregon, and Franklin Park, Illinois.

WINCHES FOR ALL INDUSTRIAL TRACTORS

CARCO

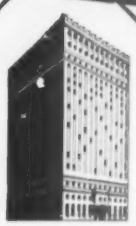


Ready-Cut HOUSING
Makes a Hit with Employees

• READY-CUT'S 1- to 3-bedroom HOUSTON HOMES are popular throughout the oil industry. Design, materials, workmanship and "extras" are top quality. These houses are tailor-made for each climate, yet available immediately from ready-cut, prefabricated stock.
• PLANNING AND ERECTION SERVICES for one house or a hundred relieves you of responsibilities and headaches.
• LEASE RENTAL HOUSING details on request.

HOUSTON Ready-Cut HOUSE CO.
Prefabricators Since 1917
CABLE: REDICUT P. O. BOX 124 PHONE: FA-9368
HOUSTON, TEXAS

BUSINESS and Pleasure in TULSA means-



➤ AIR-CONDITIONED COMFORT
➤ CENTRAL LOCATION
➤ CONVENIENT COFFEE SHOP
➤ NEW MODERN ADJOINING GARAGE

THE MAYO
TULSA'S FINEST HOTEL
Home of the Popular Terrace Room

REFINING

Pure Lets Contract for New Catformer at Heath Refinery

HEATH, Ohio.—Pure Oil Co. has contracted with M. W. Kellogg Co. for erection of a 3,000-bbl. catalytic reformer, which will use the newly developed Sinclair-Baker platinum catalyst, at its refinery here.

Pure Oil is the second company to announce plans to build a unit which will use the new catalyst. Engineering for the new plant is under way with construction to start within 2 months. It is scheduled to be completed next spring.

Pan Am to Build 25,000-Bbl. Refinery on Virginia Coast

NEW YORK.—Pan American Refining Corp. will build a 25,000-bbl. per day refinery on Chesapeake Bay in York County, Virginia.

The company has acquired options on a site, in Goodwin Neck near Newport News. Present plans call for construction to start within 6 months, with completion set for late 1954.

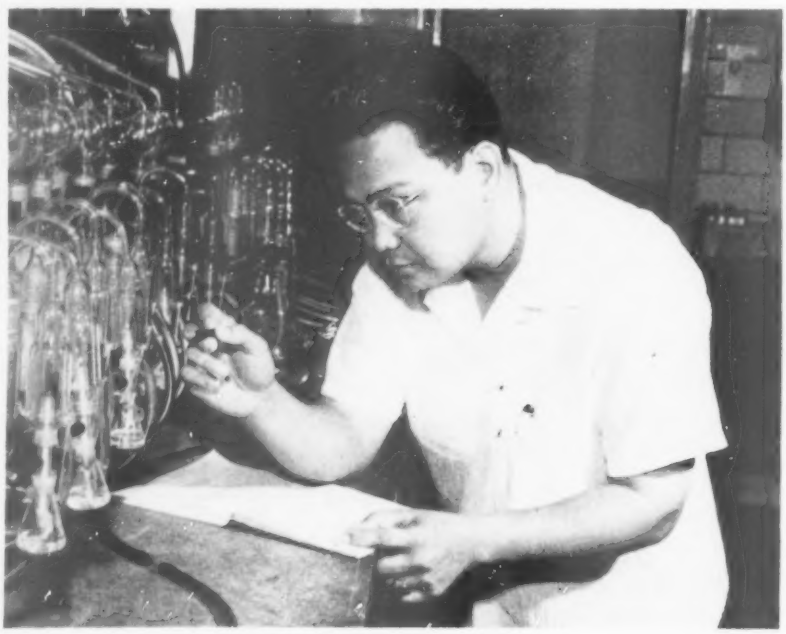
Recently, when a certificate of necessity was issued for the refinery, company officials said the new facilities would be built at a point easily reached by ocean-going vessels. At that time the company was considering building sites on the Delaware River in New Jersey, Narragansett Bay in Rhode Island, and Chesapeake Bay in Maryland *(The Oil and Gas Journal, June 29, page 137)*.

Cars to Use 95 Octane Gas Soon, Du Pont Official Says

HOUSTON.—Motorists will be using gasoline of 95 octane in automobile engines with compression ratios of 9 to 1 or better by 1955, according to an automotive technologist for E. I. du Pont de Nemours & Co., Inc., of Wilmington, Del.

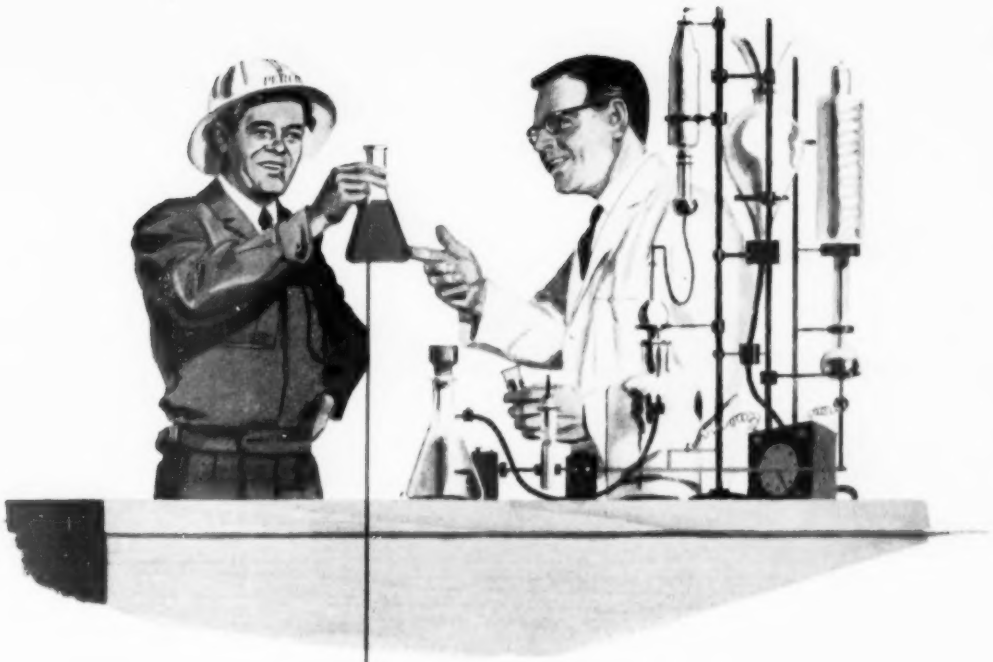
Paul H. Richard, who addressed a meeting of the Texas Gulf Coast section of the Society of Automotive Engineers, said he based his predictions on trends and reports he has received from automotive engineers.

Premium-gasoline octane numbers



U. S. Aids Philippine Refining Industry

Sixto Acuna, a 32-year-old chemical engineer from Manila, represents the vanguard of technical Filipinos who are to receive on-the-job refinery training in the United States as part a refining industry in the Philippines. He is now working at the Marcus Hook, Pa., refinery of a joint plan of the Philippine Government and the U. S. State Department to promote of Sun Oil Co. which is sponsoring his 2-year training period here. The Philippine Government plans to license a private company to build the first refinery in that country in 1955.



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now average 91.5 for the nation, regular gasoline, 85 octane, Richard said.

Sunray Places 1,500-Bbl. Alkylation Unit on Stream

DUNCAN, Okla.—Sunray Oil Corp. has started producing 1,500 bbl. daily of high-octane aviation alkylate from its new $1,700,000 HF alkylation unit here.

About 1,800 bbl. per day of butene and butylenes from the refinery's cat cracker are used to process the alkylates, which are blended with other components into aviation fuel and consigned under contract to the U. S. Government. The investment cost of the new unit is amortized over a 5-year period due to its defense production uses.

Taylor's Second Platformer Goes on Stream in Texas

CORPUS CHRISTI.—Taylor Oil & Gas Co. has placed a 5,000-bbl. Platformer on stream at its refinery here, becoming the first independent refiner to have two such units in operation.

The new installation is designed to produce motor-fuel blending component but can be converted to aromatics production. The company's other Platformer is located at Port Isabel, Tex.

Refining Briefs

NEW YORK.—The Atlantic Refining Co. has announced a new automotive lubricating oil. Atlantic Premium Motor Oil, designed to combat engine knock and preignition. The oil will have a high film strength, oxidation stability, heavy duty detergency and rust and acid corrosion protection. It will be available in the 17 Eastern Seaboard states, comprising Atlantic's marketing areas, this week.

BALTIMORE.—Esso Standard Oil Co. will bring together all the mechanical shops, tool rooms and safety storeroom under one roof in a new 54,000 sq. ft. central shop to be built at the 60,000-bbl.-per-day refinery here. Better shop efficiency and the ability to fabricate more materials will result from the move. The maintenance building will have an interlocking overhead craneway to permit movement of materials from shop to shop.

WHITING, Ind.—Seven university professors recently wound up a summer of consulting work with Standard Oil Co. (Ind.) at its research laboratories here. Each was assigned to research units in his own field of interest.

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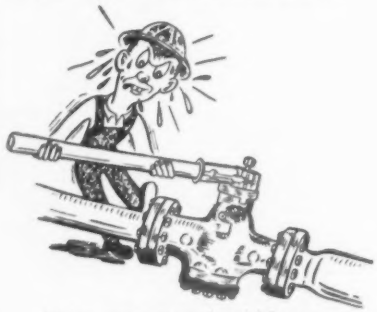
DON'T LET THIS HAPPEN TO YOU!
USE DESCO LUBRICANTS



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DESCO LUBRICANTS are chemical compounds and not just plain greases. Each one is compounded to do a particular jab and do it well. No fillers are used. No inert material. That's why there is no coking, no "hardening of the arteries." It also explains why DESCO retains all its lubricating qualities, and does not bleed or deteriorate in storage.

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That's right, only 4 DESCO LUBRICANTS will handle all the lubricated plug valves you have, no matter what their service—hydrocarbon, acid, caustic or LPG. Think what this means in reduced warehouse stocks and the possibility of using the wrong lubricant.

CONVENIENT STICKS OR BULK

Packed in clean, convenient sticks to fit Delta Gun, or in smaller sticks for jack screw lubrication, or in drums for volume lubricators.

Write for Valve Technical FILE

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give exploration flexibility

...from the air
...on the ground
...under the sea

Modern science has given oil exploration operations a global scope. Probing for oil under mountains, deserts, oceans and jungles demands flexibility of equipment. Such flexibility is inherent in Cannon's vast line of electric connectors... the world's largest and most versatile line.

FOR AERIAL EXPLORATION

For aerial exploration with magnetometers and "flying laboratories" Cannon's K Series provides 3 basic shell designs 1 to 82 contacts and 204 contact layouts. Designed for aircraft uses, particularly on sensitive electronic equipment, Cannon's K Series play a vital role in the success of aerial oil exploration activities.

FOR SURFACE EXPLORATION

For surface exploration over all kinds of terrain and in all kinds of weather, Cannon's XK Series provides the required flexibility for seismometers, amplifiers and dynamic recording equipment. With strong zinc or steel shells, moisture resistant insulation and special Acme thread coupling, the XK Series is well adapted to geophysical exploration.

FOR UNDERWATER EXPLORATION

For handling seismographic circuits under water, Cannon's W Series offers 4 shell designs, from 1 to 52 contacts and 53 layout variations. Featuring heavy brass shells, and special sealing rings, Cannon's Waterproof Connectors perform without fail under the most rugged service conditions.

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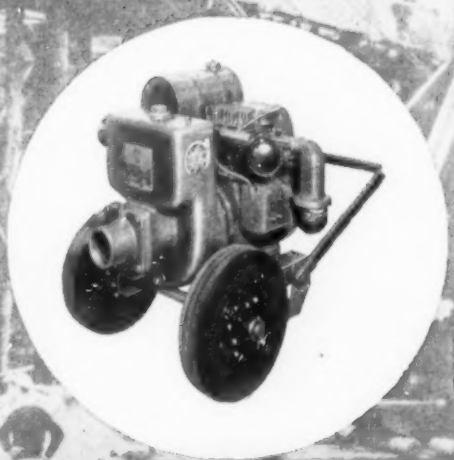

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Among the Drilling Contractors

Two Contractors Drilling On Murphy Montana Unit

Murphy Corp., of El Dorado, Ark., continues to use two contractors in the development of its unitized East Poplar block in Roosevelt County, Montana. The contractors, Cook Drilling Co., Fort Worth, and Penrod Drilling Co., Shreveport, have a rig each in operation. Both currently are working in the north end of the unit.

Cook, now drilling 29 Unit, in 28-29-51e, is using an Atlas draw works, powered with two LRO engines having 750 hp., a Model C-350 7¼ by 14-in. main pump, a Model 150 6¾ by 14-in. standby and auxiliary pump, and a 127-ft. jackknife derrick. Penrod's rig, now on 28 Unit, in Section 28, includes a National draw works, powered by two G.M. diesel engines with 640 hp., two Model WS 7¼ by 14-in. pumps, and a 129-ft. jackknife derrick.

Participants in the unit with Murphy Corp. as the operator include Carter Oil Co., Phillips Petroleum Co., and Placid Oil Co.

Neal Drilling Co. will be the contractor on Southern Minerals Corp.'s new 5,500-ft. test, 1 Bagby-Germer, in the East Cordele area of Jackson County, Texas Gulf Coast. The test, a semiwildcat, is ¾ mile southeast of the area's discovery well.

Rowan Drilling Co., Fort Worth, has a rig working for Midland Gas Co. and Chicago Corp. on an extension test for the new Dora North field, 5 miles north of Dora, in eastern Nolan County, West Central Texas. The new operation, 1 TXL, in Section 59, Block 20, T & P Survey, is about 1¼ miles southeast of the recently completed discovery well.

Paul F. Rutledge Drilling Co., Santa Fe., N. M., has the contract for another Madison test which M. B. Rudman and associates will drill in the Beaver Lodge field, Williams County, North Dakota. The new operation, 1 Ramberg, is in the C SW SE 29-156n-95w.

Falcon Seaboard Drilling Co., Tulsa and Houston, has a new contract job under way for Southern Minerals Corp. of Corpus Christi at a wildcat location northeast of Trilby, in northern Arcadia Parish, Louisiana Gulf Coast. Location at 1 Frey, in 24-7s-1w, is midway between the Mowata and Richie fields.

W. R. Cotton, Inc., has contracted for a 4,500-ft. test to be drilled for Hawn Brothers at 1 Gutierrez, a wildcat test, 19 miles northeast of Zapata, in Zapata County, Southwest Texas. Location, in Block 5, Blair & Son Subdivision, Las Comitas Grant, is 1½ miles northeast of the Comitas field.

H & J Drilling Co. is drilling for Harris S. Stahl at a wildcat location 2½ miles south of Hobson, in Karnes County, South Texas. Location is at 1 Huehlefeld, in the Don Erasmo Se-

On the floor of a Hewgley Drilling Co. rig operating in the Vealmoor area of northern Howard County, West Texas. Left to right: J. O. Lawson, driller; Jack London, tool pusher; and T. O. Pynes, B. L. Laxton, F. E. Richardson, and C. C. James, crewmen.

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guin League, about ¾ mile east of the Hobson field. Contract is for a 4,200-ft. test.

C. C. Gilger Drilling Co., Houston, is moving a heavy rig to a wildcat location 4 miles east of the Sweet Lake field, in Cameron Parish, Louisiana Gulf Coast, where it will drill an 11,000-ft. test for Howell, Holloway & Howell of Dallas.

Richardson Drilling Co. has a rig working for Thomas Brothers and Gilcrease Oil Co. at a wildcat location, 1 Boothe, 3½ miles southeast of Charlotte, Atascosa County, Southwest Texas.

Field Drilling Co. has contracted with W. Earl Rowe for a 6,500-ft. wildcat test, 2 Regina Gayle estate, to be drilled in the Nestor Clay Survey, 2 miles west of Ganada, eastern Jackson County, Texas Gulf Coast.

Texita Drilling Co. is starting a 6,500-ft. test northeast of the Farenthold field, in northwestern Nueces County, Texas Gulf Coast. It is a contract job for George E. Farenthold of Corpus Christi. Location is at 1-A Knolle.

Loffland Brothers Co., Tulsa, is drilling for Sunray Oil Corp. at a rank wildcat location near Ouray, 70 miles south of Vernal, in northeastern Utah. The test, 1 Utah Corp., is the operator's first in the state. Hole is projected to 6,000 ft.

Charles Long Drilling Co., Big Spring, Tex., is drilling for Union Oil Co. and Sun Oil Co. on a projected 7,000-ft. wildcat test located in 74-22-T&P. Survey, 2¼ miles east of the Mar-Tex field, 10 miles southeast of Sweetwater, Nolan County, West Central Texas.

ACTIVE ROTARY RIGS*

Area—	Week ended 9-14-53	Change week ended 9-7-53	Change week ended 9-15-52
Gulf Coast	501	—12	— 2
N. & W. Tex.-N. M.	790	—29	+ 66
Ark.-N. La.-E. Tex.	179	— 6	+ 43
Oklahoma	351	— 6	+ 30
Kansas-S. Nebraska	154	—11	— 1
Illinois-Eastern	148	+ 4	+ 3
Rocky Mountains	275	+ 2	+ 20
Pacific Coast	173	— 3	+ 15
Total U. S.	2,571	—61	+174
Western Canada	177	—10	— 8
Total	2,748	—71	+166

*Courtesy Hughes Tool Co. Trends in drilling activity in the United States, North and West Texas-New Mexico, and Oklahoma-Kansas are shown on pages 402 and 403.

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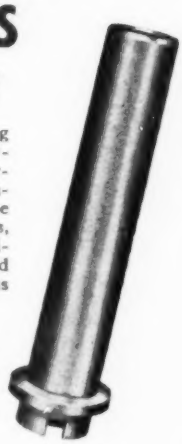

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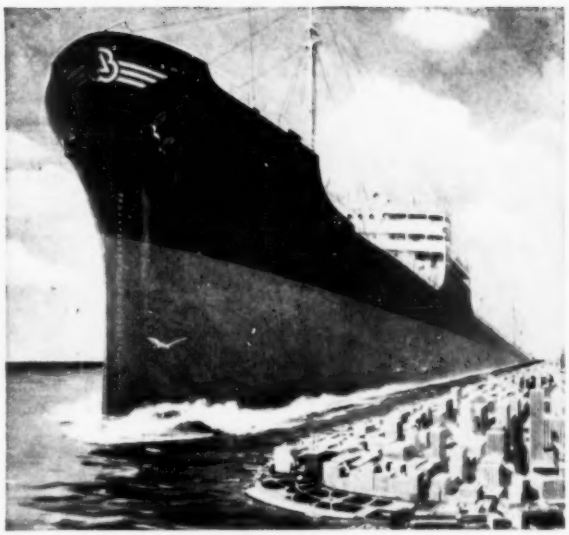

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In 1952, the Cities Service tanker fleet transported 52,540,000 barrels of crude oil and product. To handle that cargo, in one load, would have required a tanker at least 45 miles long.

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A Fluor Pulsation Dampening Piping System smooths out the "puffs" created by reciprocating action of compressors. It eliminates one of the chief causes of piping vibrations. A smooth, steady gas flow incurs less frictional resistance and reduces line breakage due to pipe fatigue. Without dampeners there is no alternate solution: *no matter how well pipe is anchored, the basic pulsations remain* – to cause problems with metering accuracy and plant safety.

For new construction, Fluor supplies the complete piping system, prefabricated, ready for installation. Pulsation dampening is designed right into the basic compressor system through an engineered selection of bottles, headers and laterals. *It is built in, not added on.* And it costs little more than a conventional system because it eliminates expensive pipe anchoring and allows the design of related equipment based on a system free of pulsative flow.

For existing construction, Fluor's two "package-type" Pulsation Dampeners, in both manifold and in-line types, are easily installed in existing plants with an excessive vibration problem. The Fundamental Dampener minimizes objectionable pulsations while providing the continuous advantages of low pressure drop and less stress on piping, heat exchangers and vessels. The High Frequency Dampeners are supplied where pulse frequencies are in the range of the second harmonic or higher.

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Manned by capable engineers experienced in the phenomena of sound and vibration, Fluor's Mobile Research Lab is fully equipped to conduct on-the-spot tests to determine the source, extent and best means of eradicating plant piping vibration.

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Fluor Pulsation Dampeners curb vibration caused by reciprocating action of compressors.

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Before you build, investigate Fluor Pulsation Dampeners and Piping System. Write for Bulletin PDS-8501.

NATURAL GAS

FPC Given Full Authority Over Gas Exports, Imports

WASHINGTON.—The Federal Power Commission now has full authority over the export or import of natural gas.

Under an executive order issued by President Eisenhower the commission is authorized to issue permits for the construction, operation, maintenance, and connection, at the U. S. border of facilities for the importation or exportation of natural gas. Heretofore, such permits were issued by the President.

The President's order directs continuance of the present procedure, whereby applications for authority to export or import gas are filed with the FPC, which obtains the recommendations of the State and Defense departments. But instead of submitting its recommendations to the White House for issuance of a presidential permit, the commission hereafter will issue such permits over the signature of the chairman.

It is provided, however, that in any case where the FPC, the Secretary of State, and the Secretary of Defense cannot agree as to whether a permit should be issued, the commission shall submit the application, with the respective views of the FPC and the two secretaries, for decision by the President.

The commission used its new authority to give Tennessee Gas Transmission Co. final authority to export natural gas to eastern Canada. The FPC approved the company's application to build and operate the needed facilities September 1 but said Tennessee Gas could not carry out its export plans until a presidential permit was granted.

Cause of Seepage at Vast Storage Project Found

CHICAGO.—Gas seepage which stopped work on the huge $50,000,000 underground-storage project near Herscher, Ill., recently has been traced to a leak in one of the project's 21 injection wells, according to Peoples Gas Light & Coke Co. officials here.

It was reported that after the leak was stopped seepage from water wells and an abandoned oil well at the site of the reservoir had virtually ceased. Work on the project is expected to resume soon.

Despite the delay, company officials anticipate having 20,000,000,000 cu. ft. of gas stored in the reservoir by January 1954. Maximum storage capacity of the project, which will be the largest in the nation, is expected to be about 90,000,000,000 cu. ft. *(The Oil and Gas Journal, August 24, page 174).*

Railroad Commission Reports May Gas Production Totals

AUSTIN.—An estimated 432,096,924 M.c.f. of gas was produced in Texas during May, according to the Texas Railroad Commission.

As usual, transmission took the majority of the monthly production. This outlet claimed 278,298,839 M.c.f., or 64.41 per cent of the gas produced. Of this amount 184,588,800 M.c.f. was exported from the state.

Of the remaining amount of gas, approximately 42,346,287 M.c.f. was cycled; 33,085,252 M.c.f. went for plant fuel and lease use; 25,047,969 M.c.f., was used in pressure maintenance and repressuring; 20,673,941 M.c.f. was vented; 15,088,888 M.c.f., represented extraction loss in plants; and 38,191 M.c.f., represented plant meter difference.

Oklahoma Body Refuses to Fix Ringwood Minimum Price

OKLAHOMA CITY.—The Oklahoma Corporation Commission has refused a second time to fix minimum well-head prices for natural gas in the multizone Ringwood field in Major County.

The latest attempt was made by Stanley Coppock, landowner and operator in the area, who sought to have the price raised from 2.75 cents to 10 cents per thousand cubic feet. The first application seeking the price hike was made last March by W. D. Greenshields, royalty owner.

Both cases evolved around a 1951 contract in which the field's operators agreed to sell all well-head gas to Warren Petroleum Corp. and Oklahoma Natural Gas Co. at a price based on recovery of liquid hydrocarbons. Last year the two companies opened an extraction plant in the field. They have contended that the plant operation is a "salvage" proposition and could not be maintained profitably if gas prices were raised.

In denying the Coppock application, the commission stated that the testimony showed that "the granting of this application would encourage waste rather than prevent waste, in that the operators of the plant would not and could not have paid for the gas at the well head any sum greater than the price contracted to be paid therefor."

July Gas Sales Drop Sharply

NEW YORK.—July natural-gas sales, which totaled 3,320 million therms, were down 241 million therms over the preceding month, but were 9.9 per cent higher over sales of 3,021 million therms in July 1952, according to the American Gas Association here.

Sales for the 12-month period ending July 31, 1953, amounted to 52,347 million therms as compared to 46,804 million therms for the previous year. This was an increase of 11.8 per cent. The association reported that the July index was 172.4 per cent of the 1947-1949 average.

Natural Gasoline

Dow Washing Out L.P.G. Storage Near Stratton Ridge

FREEPORT, Tex.—Dow Chemical Co. has drilled a pair of wells at Stratton Ridge, Tex., to 2,000 ft. in a salt section to wash out two underground cavities large enough to store 300,000 bbl. of L.P.G.

One of the cavities will hold 100,000 bbl. The other 200,000 bbl.

Work on the project is being handled by the brine-production and chlorine departments of Dow.

The cavities are expected to be ready for use this fall.

This is Dow's first venture into underground L.P.G. storage.

Skelly Pushes Storage Project

McPHERSON, Kans.—Current leaching-out operations by Skelly Oil Co. will expand capacity of its big L.P.G. underground-storage project 8 miles west of here to about 248,000 bbl. next spring.

The firm now has about 47,619 bbl. of propane stored in a cavity washed out of a salt section topped at 424 ft. It has completed drilling of a second injection well on the 48-acre tract and begun wash-out operations for the second cavity. A third injection well is now drilling.

Brine from the wash-out operations is being disposed of by a well completed at 4,300 ft. in a porous limestone formation. The company also has completed construction of three 712-bbl. tanks.

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PIPE LINE

Products Line Set

East Chicago outlet to run 215 miles into Wisconsin

BARTLESVILLE, Okla.—The newly organized Badger Pipe Line Co. will construct a 215-mile products system from East Chicago, Ind., to Madison, Wis., for Cities Service Oil Co., Sinclair Pipe Line Co., Pure Oil Co., and The Texas Co.

Construction on the $15,000,000 system, which will compose the first products line in Wisconsin, will begin next spring with completion set for late 1954. Cities Service Pipe Line Co. personnel, working through Badger, will build and operate the line.

Construction plan . . . The 65,000-bbl.-per-day system will run from East Chicago to Madison, through Chicago and Rockford, Ill. It will consist of 197 miles of 12-in. and 18 miles of 10-in. line. An existing 67-mile, 8-in. products line between Peru, Ill., and Rockford will be purchased for the system.

In addition, three pump stations and four terminals will be built. The terminals will be located at Harlem Avenue in Chicago, Des Plaines, Ill., Rockford, and Madison.

Contract Let for Sunray's 440-Mile Products Line

NEW YORK. — Ford, Bacon & Davis, Inc., has contracted to handle engineering and construction of Sunray Oil Corp.'s proposed 440-mile, 10-in. products line from Duncan, Okla., to a point on the Mississippi River near Memphis.

Presently, the engineering firm is engaged in purchasing the right-of-way for the new line. Later the company plans to contract for pipe-laying operations.

West Section of Wolverine Line Nears Completion

NEW YORK. — Midwestern Constructors, Inc., has completed pipe-laying operations on 65 per cent of the western section of Wolverine Pipe Line Co.'s 300-mile, 16-in. products line, from East Chicago, Ind., via Toledo to Detroit.

The completed section extends 153 miles from the east side of the Kalamazoo River in Michigan to East Chicago. The entire system is scheduled to be completed early next year. When placed in operation, it will have a capacity of 95,000 bbl. daily.

The line is owned by Shell Oil Co., Cities Service Oil Co., and The Texas Co.

Work Begins on Magnolia's North Texas Crude Line

DALLAS.—H. B. Zachry, San Antonio, has started laying all sections of a 154-mile, 16-in. crude line from Ringgold to Corsicana, Tex., for Magnolia Pipe Line Co.

One section runs north from Corsicana, and the other portion extends north from Keller, Tex., to Ringgold. In addition, construction has started on a main-line, all-electric pump station at Corsicana. The station's facilities will include two 120,000-bbl. storage tanks.

When the entire project is finished in December, the line will carry 80,000 bbl. of crude daily from North Texas and Oklahoma fields to the Corsicana terminus *(The Oil and Gas Journal, July 13, page 167).*

California Gas Companies Laying 73-Mile, 30-In. Line

LOS ANGELES.—Work started last week on a 73-mile, 30-in. natural-gas line in Riverside County, California, for Southern California Gas Co. and Southern Counties Gas Co.

The new loop line, which is being laid by River Construction Co., of Fort Worth, will run parallel to the original "Biggest Inch." It is expected to be in operation by January 31, 1954.

The new $5,300,000 addition is part of a $210,000,000 expansion program to supply California with an additional 300,000,000 cu. ft. of gas daily from West Texas and New Mexico fields. About half of this supply will go to the two Southern California companies and the other half to Pacific Gas & Electric Co.

Construction of the new loop will be divided into three sections with one segment running 37.5 miles paralleling the present line from Blythe, Calif. The other two portions will include 33.5 miles of 30-in. pipe between Whitewater and a point near the Cactus City, Calif., booster station.

By constantly expanding that 214-mile portion of the Texas-California line between Blythe and Los Angeles,

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the two Southern California firms have increased their original investment in the system from $12,000,000 to over $40,000,000 during the past 6 years. Along with their supplier, El Paso Natural Gas Co., the three West Coast gas companies will have a total investment of more than $500,000,000 in the 1,200-mile natural-gas artery by the end of 1954.

Pasotex Surveying for New Snyder-to-Wink Crude Line

EL PASO.—Pasotex Pipe Line Co. is surveying and buying the right-of-way for a proposed 150-mile, 10-in. crude line from Snyder to Wink, Tex.

Construction bids will be received in mid-October. It is anticipated that the line will be completed and in operation by February 1.

The new system will transport Scurry County sweet crude to the firm's existing 8-in. crude line at Wink. From there the crude will be transported to the 28,000-bbl. Standard Oil Co. of Texas refinery at El Paso *(The Oil and Gas Journal, August 31, page 150)*.

Gulf Plans 63-Mile Extension Of New Mexico Crude Line

HOUSTON. — Gulf Refining Co. here has started surveys for a 63-mile, 8 and 10-in. crude-line extension in New Mexico.

The 10-in. extension will tap on the company's existing 10-in. crude line at its Lea County station and run northward 23.4 miles. Then it will branch into a "Y" with two 8-in. lines. One line will extend westward to Anderson Ranch field, and the other will run 16.9 miles northeast to Denton field.

Construction of the extension will begin soon, and it is expected that the new line will be in service by January 1.

Mackinac Crossing Delayed

ST. IGNACE, Mich. — Stormy weather again has delayed the laying of the second 20,000-ft., 20-in. line across the Straits of Mackinac in connection with construction of Lakehead Pipe Line Co.'s 644-mile crude line from Superior, Wis., to Sarnia, Ont.

Originally this part of the project was scheduled to get under way September 6 but has been delayed repeatedly due to inclement weather. Crews have been able, however, to carry out dredging, trench-cleaning, and cable-pulling operations in preparation for the pulling of the pipe.

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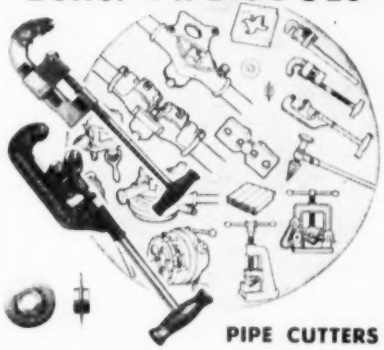

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LEADING THE FIELD OF SEISMIC EXPLORATION

EXPLORATION

New Oil Province Indicated

by Philip C. Ingalls

A SUBSTANTIAL recovery of 35°-gravity oil from the Knox dolomite of Cambro-Ordovician age has been made by Magnolia Petroleum Co. 1-A Snow in western Monroe County, Mississippi. This apparent discovery indicates that hydrocarbon production in the Black Warrior basin is not going to be restricted to gas and high-gravity distillates.

The Black Warrior basin of northern Mississippi and northwestern Alabama gained national recognition as a promising gas province with the 1952 completion of an abandoned strat test for a calculated open-flow potential of 35 M.M.c.f. of gas daily with an estimated 10 bbl. of 66°-gravity condensate per million cubic feet of gas. Four additional gas discoveries have been made in the area during the past 10 months, one of which produces wet gas. All five of these discoveries produce from rocks of Mississippian-Chester age and all are located within 20 miles of Magnolia 1-A Snow. (See page 386 for most recent report on the 1-A Snow.)

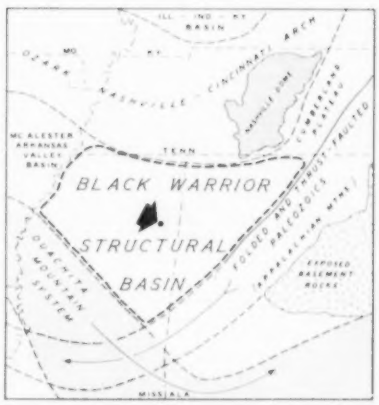
Black Warrior is a structural basin composed of remnants of two pre-Permian sedimentary units:

1. The southern tip of the pre-Devonian Appalachian geosyncline which ran northeastward from northern Mississippi across northern Alabama, and on north into Pennsylvania. This trough received more than 25,000 ft. of sediments, chiefly limestones and dolomites, during Cambrian, Ordovician, and Silurian times.*

2. The eastern portion of the Arkansas basin and the southwestern portion of the Coosa basin, both of late Paleozoic age. The Arkansas basin existed in Arkansas and northern Mississippi and merged with the Coosa basin of northern Alabama, eastern Tennessee, and on to the northeast. This unit received up to 15,000 ft. of sediments, chiefly clastics, during Mississippian and early Pennsylvanian times.

Mesozoic sediments are present in all but the northeastern corner of the Black Warrior basin but they belong to the Gulf Coastal Plain, which grew northeastward across the remnant prism of Paleozoic sedimentaries.

*A preliminary map of the top of the Ordovician compiled by W. C. Perryman, with E. B. LaRue, Athens, Tex., shows the deepest part of the present-day basin in southwest Lowndes County, about 35 miles south of Magnolia's well.



Geologic setting of the Black Warrior basin. Arrow points to Magnolia's Ordovician-Knox discovery.

The limiting features of the Black Warrior basin began to develop during late Mississippian and early Pennsylvanian time when the basin's northern edge was established by the uplift of the Cincinnati - Nashville - Ozark domes. The southeastern and southwestern limits were formed during late Pennsylvanian and Permian time when the present-day Appalachians developed in all but the southern tip of the Appalachian geosyncline and the Coosa basin; and the Ouachita Mountain system destroyed all but the eastern end of the Arkansas basin.

During Permian time this area was subjected to erosion and remained high until late Jurassic time when seas began to encroach from the south.

Though known to have porosity development, the Knox has been looked upon as a poor prospect because of its metamorphic tendencies. The recovery of oil at rates up to 30 bbl. per hour through a ½-in. choke abruptly changed the attitude toward the potentialities of the Knox. The basin area updip to the north and the arms of the basin, the Cumberland Plateau and the eastern Arkansas River Valley, have suddenly become exciting hunting grounds.

Reference

A. J. Eardley's "Structural Geology of North America," especially paleotectonic color plates.

Correction

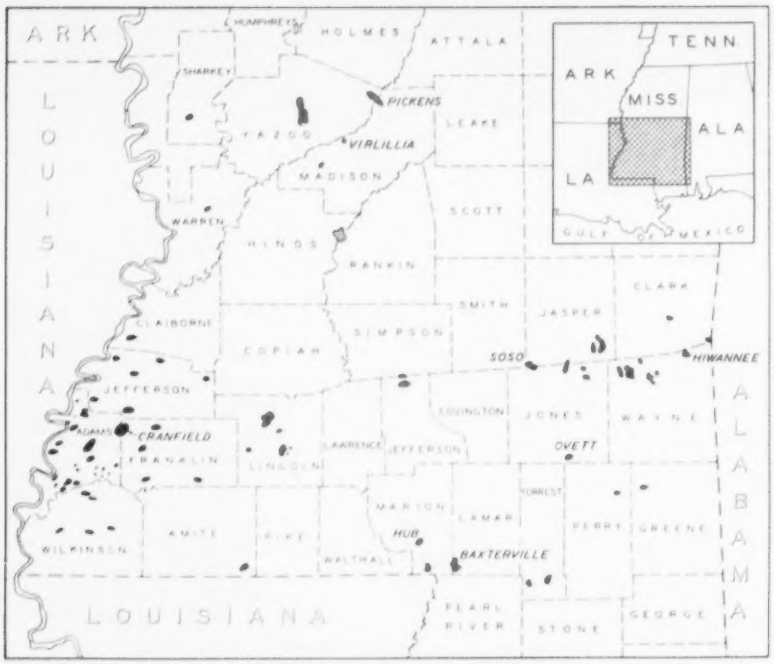
In William C. Gussow's article "Differential Trapping of Hydrocarbons," page 168, September 7 issue, Fig. 1: Illustrations of Stage 1 and Stage 2 are switched.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

FLORIDA . . . Gulf Oil Corp. recovered 40 ft. of 27.7°-gravity oil and 145 ft. of oil and gas-cut mud and no salt water on drill-stem test at 11,741-99 ft. at 1 Consolidated Naval Stores, 27-45s-26e, Lee County. The wildcat is 13 miles southeast of Fort Myers and 27 miles northwest of Sunniland field, the state's only producing area.

KANSAS . . . Just east of the vast Hugoton gas field in Seward County, J. M. Huber et al. gaged 140,865 M.c.f. of gas per day on open flow tests from the Morrow at a stepout ½ mile north of Liberal-Light pool. Lansekan Co., Inc. 1 Wood, a 2-mile extension northeast of Liberal-Light pool, was completed for a potential of 1,082 bbl. of oil and 3,424 M.c.f. of gas per day. Oil production is from the Lansing and the gas from the Morrow.

UTAH . . . Clear Creek field in Emery County reports a 136,000,000-cu. ft. gas well. Three States Natural Gas Co. 1-X Walton, NW SE SW 19-14s-7e, is reportedly the biggest gas well in Utah. Gage was on open flow from the Ferron sand at 4,078 to 4,439 ft. Clear Creek field has 10 gas wells with a producing capacity of between 75 and 100 million cubic feet per day.



South Mississippi oil and gas fields. Named fields have, or have had, lower Cretaceous production. Others produce only from upper Cretaceous or younger horizons.

New Deep Discovery Spurs Interest in South Mississippi

Lower Cretaceous find near SoSo generally regarded as best to date from the standpoint of productivity

by Neil Williams

ADDITIONAL incentive for deeper exploration in Central and South Mississippi is being provided by the recent discovery of Lower Cretaceous oil production at SoSo, one of the area's more important Upper Cretaceaus gas-condensate fields, located at the juncture of Jones, Jasper, and Smith counties.

The discovery, as previously reported, was made by Gulf Refining Co. at its 1 Bailey, completed late in August with a potential gage of 195 bbl. of 43.7°-gravity oil per day through 7/64-in. choke. Completion was in Glen Rose sand with casing perforated opposite intervals at 11,966-74 and 11,987-90 ft. Previous production of the field, opened in March 1945, had been from Upper Cretaceous - Eutaw sands at depths of 6,450 to 6,800 ft.

Although not the first Lower Cretaceous production for the area, comprising the eastern portion of the Mississippi embayment, the SoSo discovery generally is regarded as possibly the best to date from a potential productivity standpoint. Indications are that it opens a major oil reserve, which is significant in view of the somewhat uncertain status of most of the other Lower Cretaceous reservoirs discovered so far.

Lower Cretaceous formations have been found commercially productive in seven other fields in the area. They currently are producing in only four of these fields, one (Cranfield) making dry gas, and the other three (Baxterville, Hiwannee, and Virlillia) oil and gas.

Most important of the latter fields in productivity has been Hiwannee, in Wayne County, 40 miles east of SoSo. This field, discovered by Gulf Refining Co. in April 1952, now has four Lower Cretaceous wells with total daily production averaging 300 bbl. Through June, it had produced a total of 74,986 bbl. It is the only one of the fields in which more than one Lower Cretaceous well has been completed.

First Lower Cretaceous production for the area was found in Hub field, Marion County, in June 1946. The discovery was made with a gas-condensate well completed by Humble Oil & Refining Co. in a sand at 10,100 ft. This well, the only Lower Cretaceous producer drilled in the field, has been shut in several years although still capable of producing. Before shut in, it had produced 7,124 bbl. of liquid hydrocarbons with 253,477,000 cu. ft. of gas.

Other fields in which Lower Cretaceous production has been found but which are not now producing from this formation include Ovett, in Jones County, and Pickens, in Madison and Yazoo counties. At Ovett, opened in January 1948 by Gulf Refining Co., the discovery, and so far only Lower Cretaceous producer there, ceased producing in November 1952 after recovering 65,004 bbl. It since has been plugged back and recompleted in a Eutaw sand. In the latter sand, it is the field's only producer.

Pickens' Lower Cretaceous discovery well, completed by Carter Oil Co. in

LOWER CRETACEOUS FIELDS IN SOUTHERN MISSISSIPPI

Field, county and discovery well—	Date disc. (mo.-yr.)	Production depth (ft.)	Type production	No. wells	Accumulated prod. (bbl.)	Monthly prod. (June)	Other producing formations
Hub, Marion—Humble O. & R. Co. 3 Ball	4-46	10,098-10,106	Gas-Cond.	1	7,124	Shut in	Tuscaloosa
Cranfield, Adams—California Co. 9 Lees	6-46	11,578-11,790	Dry Gas	1	Dry Gas	Dry Gas	Wilcox-Tuscaloosa
Ovett,* Jones—Gulf Ref. Co. 1 Majors	1-48	12,011-13,082	31.2° Oil	1	65,004	Abnd.	Eutaw
Pickens,† Yazoo—Carter Oil Co. 1 Wilson	2-50	7,728-37	42.3° Oil	1	9,097	T.A.	Eutaw
Virlillia, Madison—Continental Oil Co. 1 Cameron	6-51	10,546-52	39.1° Oil	1	24,794	93	.....
Hiwannee, Wayne—Gulf Ref. Co. 1-A Chapman	4-52	8,988-9,608	39.2° Oil	4	74,986	2,693	Eutaw
Baxterville, Lamar—Gulf Ref. Co. 25 Andrew	12-52	10,821-41	40.9° Oil	1	3,899	74	Eutaw-Tuscaloosa
SoSo, Jones—Gulf Ref. Co. 1 Bailey	8-53	11,966-90	43.7° Oil	1	.....	New field	Eutaw

*Discovery well produced to November 1952. Recompleted in Eutaw. †Temporarily abandoned since February 1953.

February 1950, produced until February of this year, making a total of 9,097 bbl. of oil. Since then, it has been standing as "temporarily abandoned." Pickens, discovered in March 1940, is Mississippi's second oldest oil field, producing from Eutaw sands.

Past exploration in southern Mississippi has been directed mainly to Upper Cretaceous and younger formations with relatively few scattered tests, until recent years, being carried below the top of the Lower Cretaceous. This exploration has resulted in the discovery of more than 75 fields with Upper Cretaceous formations (Selma, Eutaw, and Tuscaloosa) productive in 47, the Eocene-Wilcox in 48 (including duplications), and the Eocene-Claiborne in 2. The latter two, which produced gas only, currently are temporarily abandoned.

With first oil production opened in 1939, Upper Cretaceous fields had recovered a total of 339,710,900 bbl. of oil through the first half of this year. Wilcox fields, with first production in 1943, had produced more than 35,573,500 bbl. in the same period. Most of the Wilcox development, however, has been only within the last several years. So far, Lower Cretaceous fields, with first production in 1946, have accounted for only 183,700 bbl.

Extension of exploration in the area to potentially productive horizons below the Upper Cretaceous section has accounted for more than 25 tests already this year with 3 of these having been drilled not only through Lower Cretaceous but also into the Jurassic?-Cotton Valley and Jurassic-Smackover horizons. This deeper exploration, a substantial gain over that during the previous year, is continuing to spread not only to a growing list of existing fields producing from the upper formations but also to strictly wildcat areas.

Although the recent discovery in SoSo field is the first commercial Lower Cretaceous production uncovered in nearly a year of exploration, several of this year's deeper tests have encountered important showings with indications of possible additional production. Particularly promising was a wildcat test drilled by Gulf Refining Co. in northeastern Pearl River County. This test, although failing to produce commercially, recovered varying quantities of oil in a series of production attempts in a succession of Lower Cretaceous sands from below 13,575 ft. up to 9,450 ft.

Southeastern Drilling Co. had a prospective Lower Cretaceous discovery in Flora field, Madison County, where a sand at 9,500 ft. in the Hosston zone carried sufficient showings to justify running a string of casing and testing.

Another wildcat, drilled by Carter in northwestern Madison County, 4 miles southeast of Pickens field, also had substantial oil showings in the Lower Cretaceous, as well as indicated gas-condensate production in the deeper Smackover horizon. Production tests of the latter horizon, with total depth at 12,487 ft., yielded a substantial flow but the gas carried a substantial content of noninflammable carbon dioxide and poisonous hydrogen sulfide which led operators to abandon the well temporarily.

OKLAHOMA

New Lincoln Field Well Reports High Flow Rate

Puckett Drilling Co. 1-B Harlow, NW NW NW 34-14n-6e, second well in a new Lincoln County pool, flowed 757 bbl. of oil per day on ½-in. choke following formation fracturing.

Production is from the Prue sand perforations at 3,085-3,125 ft. Production tests are near at 2-A Harlow, SE NW NW 34, east offset to the field's discovery well. The new pool was opened by Puckett Drilling Co. at 1 Harlow in the SW NW NW 34. This discovery flowed 171 bbl. of oil per day on

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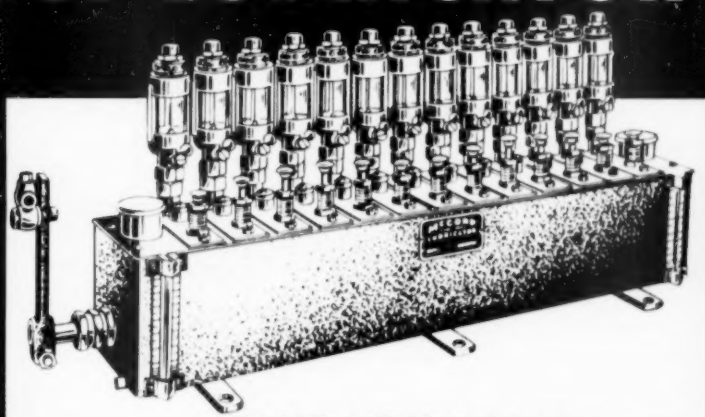

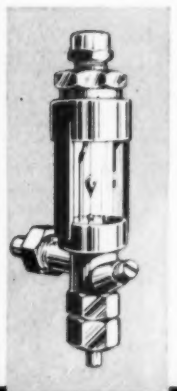

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¼-in. choke during its final tests. Previous tests flowed as much as 60 bbl. of oil per hour.

Grant Discovery Shut in

Union Oil Co. of California and Sun Oil Co. 1 Simpson, NE NE SE 29-29n-6w, Simpson sand oil discovery in northern Grant County in the northern part of the state, flowed 311 bbl. of oil in 24 hours on ½-in. choke on its first 24-hour production test. The well has been shut in. Gravity of the oil is 42°.

The Simpson discovery gives encouragement for further exploiting of the potentialities of the Ordovician-Simpson sands on the northern shelf of the Anadarko basin. The strike is on a seismic-located structure, 15 miles southwest of the nearest Simpson production in Caldwell field, Kansas, and about 25 miles northwest of the nearest Oklahoma Simpson sand production at East Pond Creek and Rich Valley fields.

The same operators are moving in and rigging up for the first offset to the strike, the 1 Dickey, SE SE NE Section 29, north of the 1 Simpson.

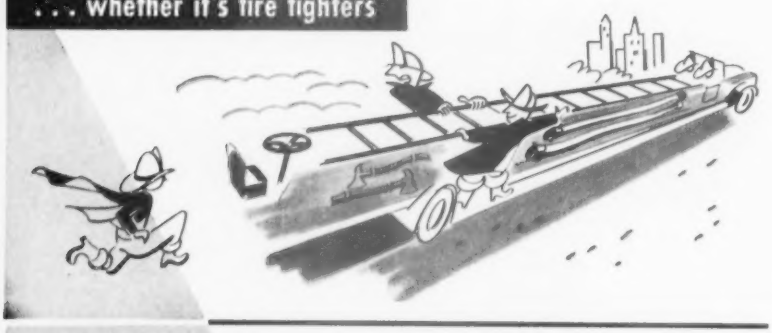
Completion Due at Second Tupelo Well

Leonard Oil, Inc. 1 Truitt, the second well in Northwest Tupelo pool in Coal County, southeastern Oklahoma, is being completed in the Bromide sand.

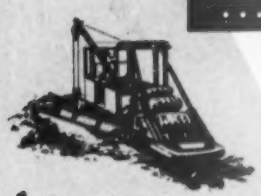
The well flowed 13 bbl. of oil per hour on 24/64-in. choke. The well is located in NW NW SW 22-2n-8e. The pool was opened last year at Sohio Petroleum Co. et al 1 Guth.

It takes a FULL team

. . . whether it's fire fighters



. . . or digging equipment



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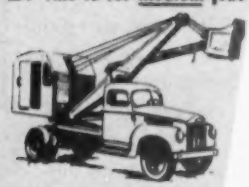

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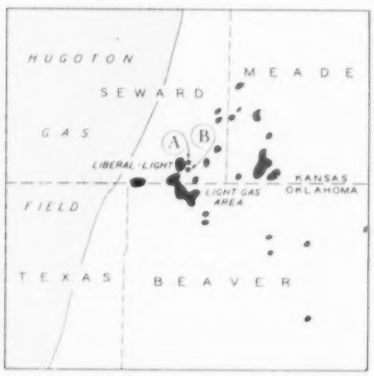
KANSAS

Extension at Liberal-Light Flows High Gas Volume

J. M. Huber et al have gaged 140,865,000 cu. ft. of gas per day through open flow tests at a deep stepout ½ mile north of Liberal-Light pool in Seward County in the Hugoton embayment.

The 1 White (B on map), C SW NW 2-35s-32w, flowed 71 bbl. of distillate in 18½ hours with 11,000 M.c.f. of gas per day from perforations in the Morrow sand which was called at 5,888 ft. Open gas flow final gage was 140,865 M.c.f. of gas per day. The excellent well is shut in awaiting connections.

In C NE SW 36-34s-32w, Lansekan Co., Inc. 1 Wood, (A on map), a 2-mile extension northeast of Liberal-Light pool, has been completed for 1,082 bbl. of oil per day and 3,424 M.c.f. of gas. The oil production is from Lansing lime and the gas from the Morrow sand. Morrow sand was found at 6,054 ft., and the Lansing at 4,408 ft.



Map of the Hugoton-Liberal-Light area in southwestern Kansas and the Oklahoma Panhandle. Important extensions and new discoveries with subsequent development have made this northwestern area of the Anadarko basin one of the most active areas in the Mid-Continent region this year.

CALIFORNIA

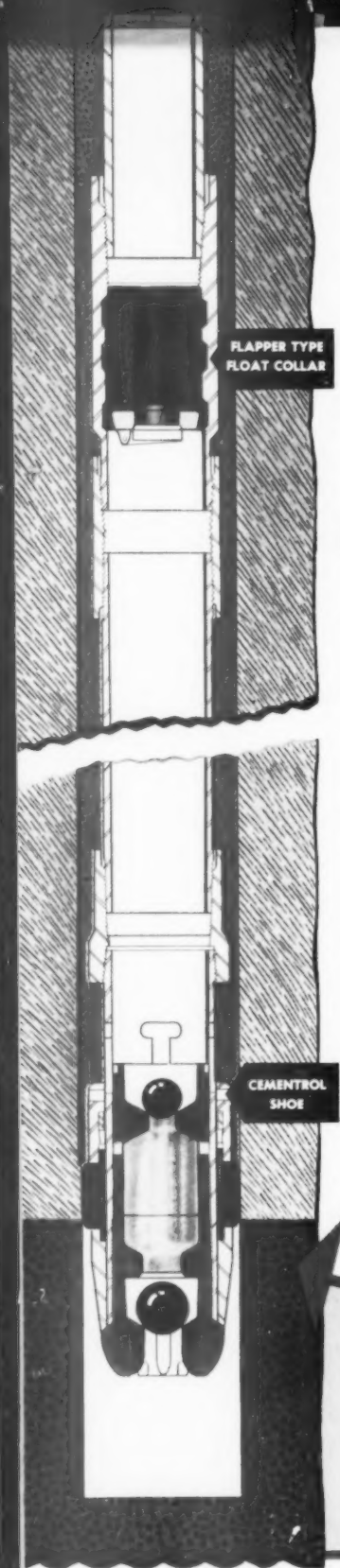
Shell Plugs Back Deep Ventura Avenue Test

Shell Oil Co. has plugged back its 15,436-ft. test in Ventura Avenue field after testing oil shows at 15,400 ft., reportedly in upper Miocene sands, for several months. The deep test, 378 Taylor in the western portion of the field, was plugged back to 13,322 ft. for completion in the D-8 zone following collapse of a liner at 13,600 ft.

The 4½-in. liner was run in June and hung at 15,431 ft. Since then intervals between 13,468-13,918, 14,099-14,649 and 14,770-15,401 ft. have been under test.

Shallow Midway Find Registered

R. E. Bering, Operator, has staked location for two offsets in the shallow Pliocene sand pool recently discovered by 23-B1 Ripley in the Santiago Creek area of Midway-Sunset field, Kern County. Completed late in August, the discovery last week was pump-



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Cementrol Shoe in the "set" position

Cementrol Shoe in "Running-in" position

Illustrated above is a typical application of the Cementrol Shoe as used to protect exposed producing formation from cement contamination. Cement is shown in red.

Flapper Type Float Collar which allows passage of bridging ball

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ing about 40 bbl. of 12°-gravity crude daily. Production was from an Etchegoin sand at 550-610 ft. The discovery and offsets are in SE SE 23-11n-23w.

Union Testing Solano Wildcat

Union Oil Co. has set 7-in. casing at a wildcat in the Honker Bay area of Solano County, 1 mile east of the Suisun gas field. Drilled to 8,966 ft., casing was cemented at 7,520 ft. Location of the possible extensioner, 1 Union-Brazos-Ward, is in 30-3n-1e. Union has approximately 3,500 acres in the general area of the Eocene test.

Guadalupe Activity

General Petroleum Corp. has staked location for a wildcat 3 miles southeast of Guadalupe field, coastal San Luis Obispo County. The test, 1 Mahoney, will be drilled in SW 9-9n-35w, or 1 mile southwest of the town of Guadalupe.

In Guadalupe field, Union Oil Co. has resumed development of the properties it acquired from Thornbury Drilling Co. earlier this year. Union C-3 Leroy was completed pumping 70 bbl. daily from 2,700-2,780 ft. and C-3 Leroy was in process of completion at a similar depth.

Standard Completes New Discovery at Buena Vista

The old Buena Vista Hills field of westside San Joaquin Valley has yielded another shallow pool discovery. Standard Oil Co. of California 73 17-D, about two locations southwest of production on the Honoluju anticline, was completed flowing 572 bbl. of oil daily from an Etchegoin (Pliocene) sand at about 3,550 ft.

The flow of 20.5°-gravity crude was through an 18/64-in. choke and was accompanied by 2 bbl. of water. Tubing pressure was 380 psi. and the casing pressure, 120 psi. Location of the new pool opener is in SE NW 17-32s-24e, in Naval Petroleum Reserve No. 2.

ARKANSAS

Smackover Pay Opened In East Lisbon Field

Curtis Kinard has completed 1 Brewster, C NW NE 23-17s-16w, opening Smackover lime production in Union County's East Lisbon field. The discovery flowed 244 bbl. of 37.4°-gravity oil per day through 12/64-in. choke. The well produces from perforations at 6,733-38 ft.

Good Tokio Well Finaled at Falcon

First Tokio production was opened at Falcon field by H. M. Mills et al 1 Russell, C SE NW NW 8-15s-22w, Nevada County. The well pumped 720 bbl. of 26°-gravity oil per day from perforations at 2,636-41 and 2,648-52 ft. Falcon field pay is Nacatoch, Rodessa, and Travis Peak.

Rank Test Slated For Conway County

Carter Oil Co. and associates have spudded in at a rank wildcat in north-central Arkansas at 1 Reynolds Metal Co., C NW SE 1-9n-16w, near Cleveland in Conway County. The remote test is located in the Arkansas River Valley basin. Nearest production is in Washington County in northwestern Arkansas. The fields in that area produce gas from the Sylamore.

LOUISIANA

SOUTH LOUISIANA

New Pay at Edgerly

Stanolind Oil & Gas Co. has opened a new Miocene pay zone in the old Edgerly field, Calcasieu Parish, at its 9 Bright-Penn fee, completed flowing 100 bbl. of 29°-gravity oil per day through ⅛-in. choke. Pay is open through casing perforations at 3,703-12 ft. The well had been drilled to 4,346 ft. Edgerly, a shallow, piercement-type salt dome, has been productive since 1912.

Deeper Sand Opened at West White Lake Field

The West White Lake field, in Vermilion Parish, added another producing zone, the deepest yet found in the field, with completion by Union Oil Co. of California of its 11 State Lease 540-B. The new sand, open through casing perforations at 11,835-40 ft., produced at the rate of 189 bbl. of 32.2°-gravity oil per day on completion gage through 8/64-in. choke. Tubing pressure was 1,725 psi. with gas-oil ratio of 772 cu. ft. per barrel. The well was drilled to 12,648 ft. and has casing run to 12,377 ft. Nearest production is from an 8,800-ft. sand.

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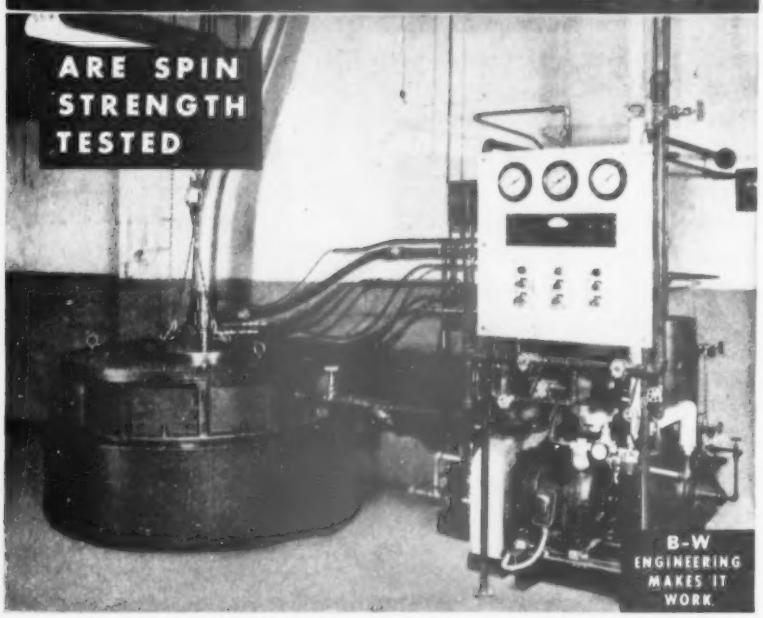

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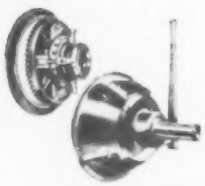

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TEXAS

WEST TEXAS

New Pay and Extension At Northeast Andrews

Phillips Petroleum Co. has added a prolific Ellenburger well to the Northeast Andrews-Devonian field at its 3-CC University, formerly designated 1-VV University. It is a new pay discovery, an eastern outpost to the field, and north of the Magutex field.

Completion potential in the Ellenburger was 1,530 bbl. of 47° oil, based on a 12-hour flow through ¼-in. choke. Top of the Ellenburger was 13,847 ft. on elevation of 3,033 ft. Operators drilled 5 ft. into the formation and completed from open hole.

The well also flowed from the Devonian, topped at 12,535 ft. A test on that formation through perforations at 12,530-12,570 ft. gaged 147 bbl. of oil in 8 hours through ⅜-in. choke. Acid treatments boosted the flow to 652 bbl. in 8 hours through ½-in. choke.

The Block 12-Ellenburger field in southwest Andrews County had its second completion in that formation at Phillips 1-PP University, in Section 20. Top of pay was reported at 10,720 ft. on elevation of 3,291 ft., and completion potential was 800 bbl. of oil a day through ½-in. choke from 33 ft. of open hole.

Wolfcamp Flow at Deep Test

Fred Turner Jr. 1 Parker, directly south of Midland, flowed an estimated 40-50 bbl. of oil hourly on a drill-stem test in the Wolfcamp between 8,554-8,613 ft. Oil reached the surface in 72 minutes and was flowed into pits for 13 minutes. Further production tests were not made and drilling continued. The well was started on a 12,000-ft. contract. Nearest production is the Parker-San Andres pool to the northwest.

Location of 1 Parker is about 5 miles west of Continental Oil Co. 1 McCollum-Weibusch, which made a 1,500-bbl. Wolfcamp discovery earlier this year after finding the Ellenburger dry. Top of Wolfcamp pay was around 8,708 ft.

NORTH TEXAS

Two Strikes for Southeast Nolan County

C. L. McMahon, Inc., 1 Sliger, 188-64-H&TC, has been completed as a Goens limestone (Pennsylvanian Strawn age) discovery, 1 mile northwest of lower Fry sand production in the Moore pool. Initial potential through 12/64-in. choke from perforations at 5,144-48 ft. was 170 bbl. of 45° oil a day. Total depth was 5,793 ft. Drill-stem tests from the Goens top ate 5,120 ft. indicated 50 ft. of pay section.

A King sand discovery was in the making at General Crude Oil Co. 1 Urey Mae Ussery, ½ mile south of Nolan in 310-64-H&TC. The well flowed 106 bbl. of oil in 24 hours through 1-in. choke from perforations at 4,162-72 ft. Testing continued. Several other sections have shown oil and first flow of oil was from perforations at 4,131-81 ft. The well had top of the Ellenburger at 6,430 ft. but reported no shows or tests.

Fisher County . . . Woodson Oil Co. 1 Knox, 2 miles northwest of Longworth, completed as a Flippen limestone discovery. Pumping potential of 163 bbl. of oil a day was from perforations between 3,622-64 ft.

Taylor County . . . Gilchrist Drilling Co. 1 John Bull, 2 miles northeast of Bradshaw, completed as a Gardner sand discovery, flowing 275 bbl. of oil a day through 18/64-in. choke. Pay was perforated between 4,424-32 ft. This well was originally drilled in April of this year and plugged at 4,552 ft.

EAST TEXAS

Smith County Has Pettit Discovery

Humble Oil & Refining Co. 1 Hubbard Timms, 8 miles northwest of Kilgore and 3 miles west of production in the East Texas field, completed as a good flowing well from Pettit limestone. Completion potential through ¼-in. choke and perforations at 8,015-24 and 8,028-32 ft. was 197 bbl. of 41° oil. Total depth of 8,323 ft. was in the Travis Peak.

TEXAS GULF COAST

Deeper Producing Sand Opened at Cecil Noble

A new pay zone for the Cecil Noble field, in Colorado County, has been opened with the completion by C. N. Housh of his 1 American Legion as a good oil producer from sand at 9,670-78 ft. The well flowed 240.05 bbl. of 33°-gravity oil per day on potential gage through 10/64-in. choke, with 1,375 psi. pressure on the tubing. The well, located in the W. B. Dewees Survey, is a west outpost for the field. The new pay is the deepest for the field. Hole was drilled to 10,320 ft.

Pumper Opens New Field

J. B. Massey has completed a small pumping well at his 1 Rentfro, a wildcat located in the B. B. Adkins Survey, 8 miles southeast of Oakville, in Live Oak County. On the pump, the well produced 16.38 bbl. of 28°-gravity oil per day. Pay is from a casing-perforated interval at 3,409-22 ft. The discovery has been designated as the Cadiz field.

TEXAS PANHANDLE

Drilling & Exploration Co., Inc. has completed its twenty-third well of a 56-well program on a block of 1,120 acres in Carson and Hutchinson counties of the Texas Panhandle.

The twenty-third well, B-5 Ware, swabbed at the rate of 400 bbl. per day. Total allowable production of the 23 wells completed by the company is approximately 1,000 bbl. per day.

Drilexco began exporing the block in January of this year and moved two company rigs to the scene in July to develop the tract.

The B-5 Ware is in an extension of Panhandle field.

It was drilled to total depth of 3,054 ft., perforated from 2,902 to 3,029 ft., and treated with 25,000 gal. of 15 per cent acid and 1,000 gal. of gell acid.

KENTUCKY

EASTERN KENTUCKY

In the Pike County sector of Big Sandy gas field, United Carbon Co. have completed 50 Colony Coal & Coke Corp. as a Berea sand (Mississippian) gas well. An open flow potential of 1,100,000 cu. ft. of gas daily was recorded at 3,073 ft. after shooting pay from 3,028 to 3,073 ft.

On Ken Smith Branch of Big Creek in

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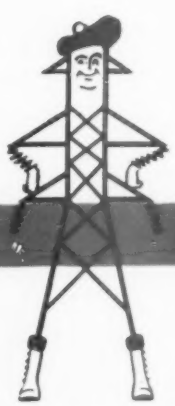

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the Pike County sector of Big Sandy gas field, Columbian Fuel Corp. have completed 1 F. M. Smith for 158,000 cu. ft. of gas daily from Devonian block shale at a total depth of 3,602 ft. Top of formation was called at 2,715 ft. and pay section was shot with 6,800 lb. of gelatin and 25 lb. of dynamite.

APPALACHIAN AREA

PENNSYLVANIA

Activity in Pennsylvania remains primarily confined to the development of the Benezette Oriskany sandstone gas field.

New York State Natural Gas Co. completed its 1 State of Pennsylvania (Tract 33) with an open flow of 7,000,000 cu. ft. daily. This well extends production 4 miles southwest of Keta's Charleroi Mountain Club lease.

Other recent extension wells include 1 Harold Pearsall of Case Pomeroy Oil Co. This well has an open flow of 25,500,000 cu. ft. daily and extends production 2 miles northeast of Sagamore Mountain Club wells.

Northwestern flank production was extended 4 miles northeast of Grant area with the completion of the 1 Vauseby Harry Wines et al. Well had an open flow of 3,500,000 cu. ft. daily.

Productive and probably productive area of the field now totals about 30 sq. miles with a proved closure of 400 ft. Daily production is approximately 150,000,000 cu. ft. from 40 wells whose open flows ranged from 1,000,000 cu. ft. to 35,000,000 cu. ft. daily.

The 1 Byron Schnyder of The California Co. in Pine Township, Lycoming County, has been cased above Oriskany sandstone in black Marcellus shale. Well will be completed with a rotary rig in near future.

Delta Drilling Co. has staked a wildcat location, 1 Ambrose Ging, in Cascade Township, Lycoming County, Pennsylvania. Test is slated to drill to Oriskany.

Several other companies have tentative plans for wildcat tests, but no definite locations are as yet available.

WEST VIRGINIA

Three new wildcat locations were announced in West Virginia. Middle Fork district, Randolph County, Blaho Oil & Gas Co. 1 M. M. Thomason, elevation 2,114 ft., Sago Quadrangle, .68 mile south of latitude 38 degrees 50 minutes and 4.3 miles west of longitude 80 degrees 00 minutes. Roaring Creek district, Fox and Trimble et al 1 King & Casad, 118 acre tract, elevation 2,526 ft., Sago Quadrangle, .78 mile south of latitude 38 degrees 55 minutes and 1.05 miles west of longitude 80 degrees 00 minutes. Glade district, Webster County, Petroleum Drilling Corp. 1 Cary S. Hines, elevation 1,693 ft., Sutton Quadrangle, 5.2 miles south of latitude 38 degrees 35 minutes and 2.4 miles west of longitude 80 degrees 30 minutes.

OHIO

B. G. Davis et al. completed a wildcat 2 miles west of the town of Coshocton on 1 C. A. Wallick, second quarter, Jackson Township, Coshocton County. Clinton sand at 3,825-83 ft. made 120,000 cu. ft. gas, and a small showing of oil natural and 335,000 cu. ft. gas after a fracture treatment. The operators are undecided about further drilling.

Shuff and Bucy 2 (9) Ray Hays, Sec. 5, Perry Township, Coshocton County, made a fairly good show of oil natural and 95 bbl. in 24 hours after fracturing. Clinton was logged at 3,177-3,225 ft.

Wellington pool was extended ⅓ mile to the west by Ohio Fuel 2 H. W. Whitney, Lot 15, Wellington Township, Lorain Coun-

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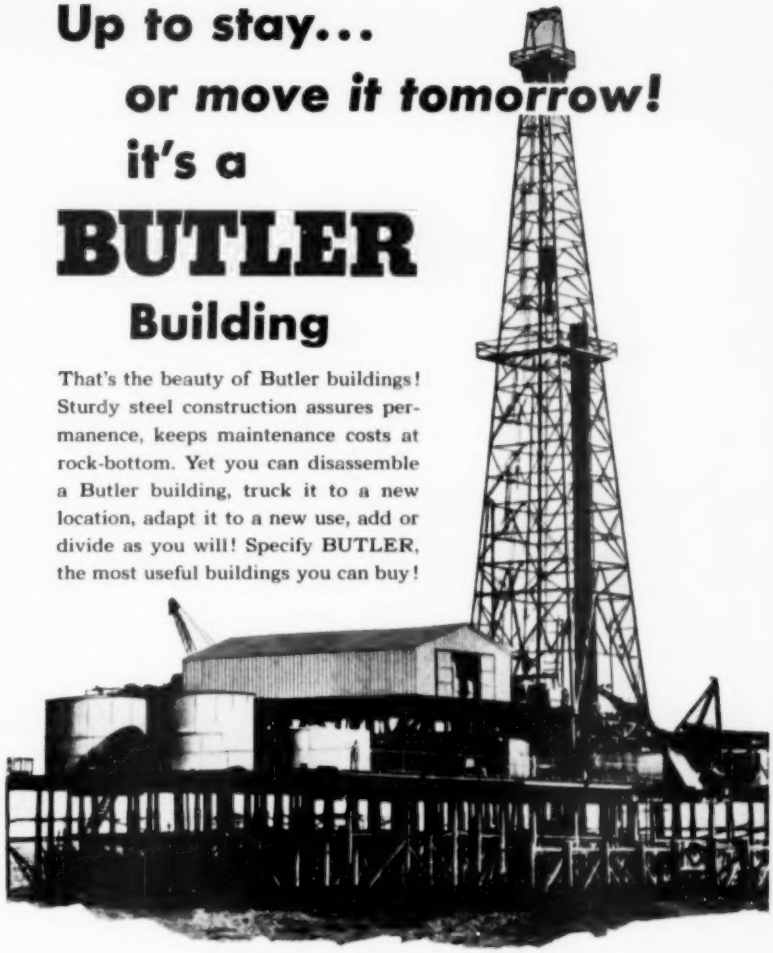

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FLORIDA

Portion of southwestern Florida showing locations of Gulf Refining Co.'s oil-showing wildcat test (A), and Humble Oil & Refining Co.'s 1 Kirchkoff (B), also testing deep oil showings.

Oil Recovered in Test Of Lee County Wildcat

Promising oil showings have been encountered by Gulf Refining Co. at its 1 Consolidated Naval Stores wildcat test in Lee County. Although not conclusive of proving commercial production in this well, they are indicative of a possible new field in the area.

Location of the test (A on map) is 27 miles northwest of Humble Oil & Refining Co.'s Sunniland field, in northern Collier County, which, discovered in 1943, has been the state's only production so far. It is 12 miles southeast of Fort Myers. Spot location is in the C NE NE 27-45s-26e.

Showings have been in the Sunniland section of Lower Cretaceous-Glen Rose age, producing horizon of the Sunniland field. Most promising showings were in a drill-stem test the past week. In this test of an interval at 11,741-99 ft. with tester open 23 hours and 41 minutes, 40 ft. of 27.7°-gravity oil and 145 ft. of oil and gas-cut mud was recovered. No water was indicated. Various cores from 9,400 ft. have had oil stains with some bleeding oil. Previous drill-stem tests, however, have not yielded oil.

At latest report, the hole was below 11,908 ft. Cores since the above drill-stem test have not shown any oil.

In the meantime, Humble Oil & Refining Co. is continuing tests at its 1 Kirchkoff, another Lee County wildcat (B on map), which has encountered showings in the same horizon. This wildcat, 11 miles west of the Gulf wildcat, was drilled to 12,877 ft. has oil-string run to 11,820 ft. It has made a series of drill-stem tests, all unsuccessful, in open hole, plugged back to 11,866 ft.

ILLINOIS

Discoveries and Extensions

Two new oil pools, one gas and five extensions to pools were completed in Illinois during August, according to the State Geological Survey monthly report.

New discoveries were Amity South and Amity West, both in Richland County; the new gas pool was Dudley West in Edgar County.

Extensions to pools were Cantrell South and Dale Consolidated in Hamilton County; Assumption Consolidated, Christian County; Maple Grove Consolidated, Edwards County and Allendale in Lawrence County. McCloskey limestone was opened as a new pay in Dix pool, Marion County.

MICHIGAN

Columbia Oil & Gas Co. 1 Custer, SW NE NW 22-17n-8w, Evart Township wildcat, Osceola County, was developing this week into being the most closely-watch wildcat drilling well in Michigan. Upper markers checked in favorably and drill-stem tests of the Michigan Stray sand showed gas, but well did not flow from this zone. Wildcat is scheduled to drill the Dundee at about 4,050 ft.

First drill-stem test in the Stray was run at 1,514-37 ft., with only a small amount of gas showing. Second test, run for 60 minutes at 1,537-47 ft., showed about 1,547 ft. of gas, 60 ft. of muddy salt water and 120 ft. of mud. Bottom-hole pressure rocked to 505 psi. in 15 minutes. Well was being drilled ahead with rotary tools to about 1,900 ft. where 7-in. casing will be run, and drilling operations standardized for deepening to the lower objectives.

Norman L. Stevens may have the lead to a new Traverse oil pool in Decatur Township, Van Buren County, at his 1 Henderson, NW NW NE 25-4s-14w. Well, which carried only a rainbow oil show natural, flowed 65 bbl. of net oil in 8 hours after acid treatments with 1,000 and 2,000 gal., quit flowing after producing about 100 bbl. of net oil. A strong gas head was reported to be in evi-

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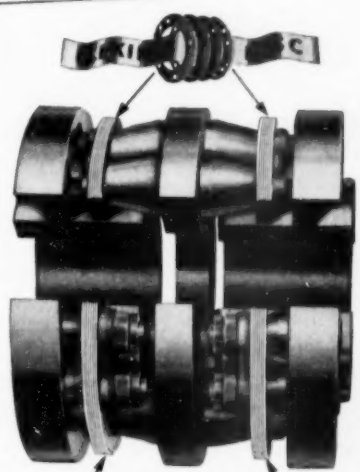

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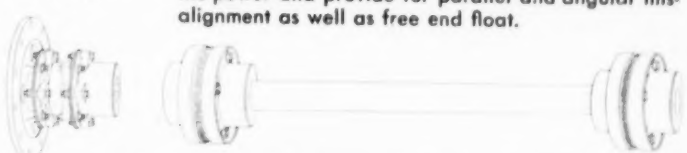

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dence after well quit flowing, and tubing and rods were being pulled to determine if failure to continue to produce was mechanical. Regardless of the eventual outcome of this wildcat, additional drilling is almost certain to follow in the area. Traverse lime was logged at 1,154 ft. and well was being tested at 1,157 ft., total depth.

CANADA

Flowing Oil Well is Promised Forget Area

The first two days of production testing at the Williston Oil & Gas, Ltd.-Bobjo Mining Co. team's Madison oil discovery in the Forget area of southeastern Saskatchewan have shown promise of a flowing oil well. One week ago Williston Oil & Gas, the operator of this exploratory test reported successful drill-stem tests in the Madison horizon. Although results of the drill-stem tests were very encouraging, the zone seemed rather tight, and it was not known at that time if commercial production could be obtained. The two days of testing at this well, September 6 and 7, have indicated not only commercial crude oil production, but possibilities of a flowing well.

This recent success, Williston Oil & Gas 1-19 Bobjo, LSD 1, 19-9-6w2, located about 90 miles east of Regina, was completed at total depth of 3,991 ft. String of production casing was landed on bottom, and perforated in the intervals 3,951 to 3,967 and 3,972 to 3,988 ft. with four shots per ft. Those perforations were acidized with 1,000 gal. and swabbing operations were commenced. A steady swab rate of 20 bbl. of clean oil per hour was established during the first days production tests. A 5-hour test, through a 24/64-in. choke on the following day flowed oil at the rate of 10 bbl. per hour. Gravity of the oil being produced was measured at 27°. Further testing is now underway.

Oilwell Operators has reported an encouraging but non-commercial showing of oil and gas in the basal quartz formations at its current D3 field development well in the Erskine oil producing area of southern Alberta.

The shows were recorded at Oilwell Operators 3-12 Erskine driller, on LSD 3, 12-39-21w4, ¼ mile east offset to the company's 4-12 Erskine D3 oil producer. Drill-stem test in the basal quartz, of interval 4,446 to 4,456 ft., with valve open 40 minutes flowed gas at maximum rate of 340,000 cu. ft. daily. The well headed up in 17 minutes, flowed mud in 18 minutes and began flowing salt water cut oil in 27 minutes. Pipe recovery consisted of 175 ft. of dark brown oil and 1,320 ft. of salt water. Drilling has been resumed and the well is heading down in search of its Devonian objective.

Shell Oil Co. has reported a D1 zone of Devonian drill-stem test at its 4 Olds, LSD 6, 9-32-1w5, which indicated 'wet gas' success for that extension venture located in southern Alberta, 4 miles south of the town of Olds and approximately 42 miles north of Calgary.

This recent success topped the D1 formation at 8,297 ft. Only reported drill-stem test in that zone was of interval 8,602 to 8,693 ft. The 1-hour test flowed gas to surface in 30 minutes, which reached a maximum daily flow rate of 3,750,000 cu. ft. Pipe recovery consisted of 90 ft. of condensate, 890 ft. of gas and condensate-cut mud, and 135 ft. of muddy fresh water.

The 4 Olds was completed at 8,737 ft. Crew of the Shell Oil Co. owned drilling rig, ran and cemented 7-in. production casing at 8,731 ft. Production casing was perforated opposite the pay zone and acidizing and swabbing operations are now underway. This new potential gasser is located about 1¼ miles west-southwest of Shell's 3 Olds 'wet gas' and light gravity crude oil success. Although never officially reported as an oil success, the 3 Olds well produced 1,702 bbl. of crude oil during its initial month of testing, June of this year.

EASTERN CANADA

Ontario . . . Drilling in Lake Erie 2 miles off shore from Port Alma, in Romney Township, Kent County, Continental West Petroleum Co. 9 finished in the Guelph-Niagara formation with initial production of 300,000 cu. ft. daily. The well caught fire. It has since been capped.

MISSISSIPPI

Production Rate Drops In Knox Discovery Well

Declining production rates and pressures are reported from Magnolia Petroleum Co.'s Knox dolomite discovery well, 1-A Snow, in western Monroe County, in the Black Warrior basin.

The well, which flowed initially at the rate of 29 bbl. of 34.6°-gravity oil per hour through 17/64-in. choke, on a late report was making 44 bbl. of oil per day through 10/64-in. choke. Flowing pressure was down from 250 psi. initially to 140 psi. Also, water has shown up, the cut being approximately 8 per cent on the late gage.

Producing interval is 4,753-56 ft., open through casing perforations.

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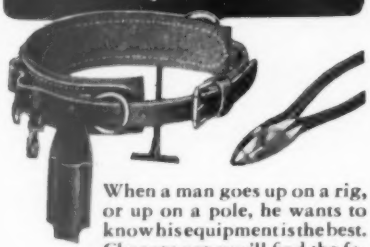

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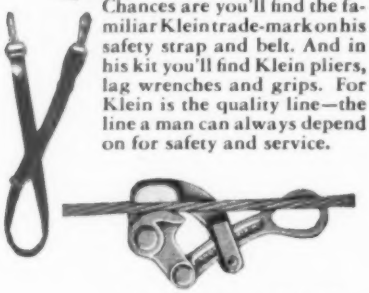

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WEST NEBRASKA

Fifth Gas Discovery For West Sidney Area

Ohio Oil Co. 1 Kurz, NE NW SE 4-13n-50w, flowed gas at the rate of 4,500 M.c.f. per day on test of the "D" sand at 4,569-89 ft. A second test at 4,589-4,606 ft. made gas at the rate of 5,053 M.c.f. per day. This discovery is the fifth gas strike in the general West Sidney area, and has indications of being one of the best. The 1 Kurz is located northeast of the nearest production.

UTAH

Big Gas Well Completed In Clear Creek Field

Emery County's Clear Creek gas field has what is reported to be Utah's biggest gas well. Three States Natural Gas Co. reported a flow of 136,000 M.c.f. of gas per day with gage on open flow from the Ferron sand at 4,078-4,439 ft. at 1-X Walton, NW SE SW 19-14s-7e. The discovery extends Clear Creek production 2 miles to the south. The field now has 10 completed producers. Producing capacity is between 75 and 100,000 M.c.f. per day.

NORTH DAKOTA

Silurian Stains Found At Ramsey County Test

S. D. Johnson is running a drill-stem test in the Silurian at 1 Wolfe, C NW NW 17-158n-62w, Ramsey County wildcat. Oil stain was found in samples of the Silurian. Total depth is 3,277 ft. and the operator has plugged back to 2,328 ft. to test. This test is about 28 miles north of Devils Lake on the eastern flank of the Williston basin. This is the first showing of oil stains in the Silurian in this part of the state.

MONTANA

Wibaux Well Tests Oil in Silurian and Ordovician

Shell Oil Co. 41-5 A, NW NE NE 5-11n-57e, Pine Unit, Wibaux County, tested oil on two tests in the Silurian and Ordovician. A test at 8,456-8,500 ft., open 2½ hours, recovered 4,800 ft. of 33°-gravity oil, 225 ft. of gassy oily mud, 25 per cent oil, and 120 ft. of gassy oily muddy water, 40 per cent oil. Recovery on the test of the Ordovician at 8,845-65 ft., open 2½ hours, was 1,520 ft. of 35°-gravity oil and 1,005 ft. of slightly oily gas-cut water.

Successful completion of this well will give Pine unit its sixth producing well. Silurian-Ordovician oil was discovered in the area in 1952 by Shell.

COLORADO

Morrison Discovery Finaled In Temple Canyon Area

Anderson-Prichard Oil Corp. has finaled 1 Government "A," SE SE NE 17-4n-95w, in the Temple Canyon area of Moffat County for a flow of 173 bbl. of oil per day from the Morrison. The well produces from 6,000-

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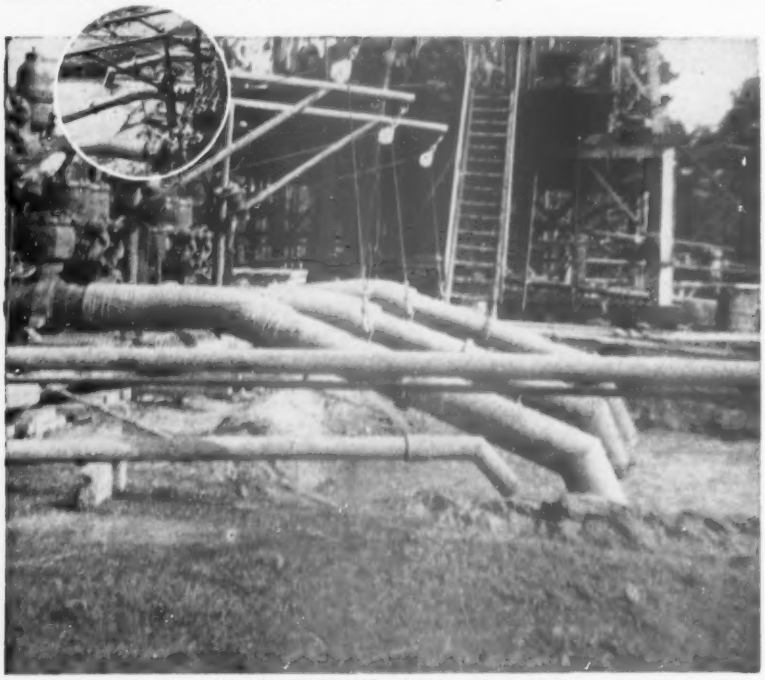

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08 ft. This discovery is 2 miles north of Maudlin Gulch field Morrison and Entrada production.

Gas Discovery in Sedgwick Apparent

Sedgwick County in far northeastern Colorado's Denver-Julesburg basin area has a new gas discovery at Stanolind Oil & Gas Co. 1 Donaldson, C SE NE 26-10n-47w. The well tested for a flow of 2,080 M.c.f. of gas per day from the "D" sand. First production in Sedgwick County was opened last year by Stanolind at 1 Franklin, C SE SE 35-12n-44w. This discovery was finaled for a flow of 7,350 M.c.f. per day.

WILDCAT COMPLETIONS

SOUTHWEST TEXAS

Atascosa County: George Delker 1 Walton, J. Poitevent Sur. 1, A-271. Dry. TD 1,805 ft.

Don F. Tobin et al 1 Marek, J. M. De La Garza Sur. 1062, A-313 ft. Dry. TD 1,970 ft.

Bastrop County: Amerada Petroleum Corp. 1 Miller, Lewis Loomis Sur. 10. Dry. TD 7,600 ft.

Bell County: Emory A. Dunnam 1 Lawhorn, J. I. Herrera Sur., A-378. Dry. TD 1,298 ft.

Cameron County: H. L. Hunt 1 Strieber, Arroyo Irrigation Farms Subd. Dry. TD 8,517 ft.

Hidalgo County: The Texas Co. 1 Guerra, Sanita Anita Grant, A-63. Dry. TD 7,515 ft.

Jim Hogg County: H. L. Hunt 1 Silver Lake, Noriecitas Grant, A-356, IP 46.75 BOPD, 3/16-in., 46.8°, Pettus sand 4,235-38 ft. (casing perforations). TD 4,270 ft. (New field—South Hebbronville.)

N. B. Hunt and W. H. Wilson 1 Holbein estate, Agua Nueva de Arriba Grant. Dry. TD 5,379 ft.

Southern Minerals Corp. 1 Gruy, Block 11, Kohler Subd., Noriecitas Grant, A-356. Dry. TD 3,838 ft.

LaSalle County: Seaboard Oil Co. of Delaware 1 Nueces, H&GN Sur. 16, A-1187. Dry. TD 6,410 ft.

Medina County: Bckman, Inc., 1 Ruskin, et al, Smith Noel Sur. 42, A-732, IPP 12 BOPD, 44°, open hole, 2,087-2,101 ft. TD 2,126 ft. (New pay in Bear Creek field).

Nueces County: Warren Petroleum Corp. 1 Halpert, Section 17, George H. Paul Subd., Driscoll Ranch. IP 339.01 BOPD, 1/4-in., 40.5°, casing perforations 5,598-5,604 ft. TD 6,918 ft. (New pay in South Robstown field).

San Patricio County: F. William Carr 1 Gaines et al, Block 21, Welder & Odem Subd. IP 4,600 M.c.f. daily, open flow, casing perforations 8,064-74 ft., and 93 M.c.f. daily, open flow, casing perforations 7,987-97 ft. TD 8,106 ft.

Vaughn, Zoch & Turnbull 2 Picha, Section 54, George H. Paul Subd. Dry. TD 7,515 ft.

Wilson County: H. R. Smith 1 Wiseman, Juan Delgado Sur., A-8. Dry. TD 3,225 ft.

Zapata County: C. J. Brown and Rowden & Rowden 1 Cuellar, TCRR Sur. 277. Dry. TD 4,807 ft. (Deeper exploratory test in Cuellar field).

TEXAS GULF COAST

Bee County: Humble Oil & Refining Co. 1 Farnish, Jose Maria Uranga Grant, A-68. Dry. TD 5,500 ft.

WILDCAT COMPLETIONS

Brazoria County: Brazos Oil & Gas Co. 1 Houston Farm Development, Pierce Miller Sur., A-348. Dry. TD 7,185 ft.

DeWitt County: George S. Hammonds 1 Leubert, C. W. Slade Sur. 19, A-434. Dry. TD 7,615 ft.

Fort Bend County: Oil Production Maintenance, Inc., et al 2 Stern, B. Wickson Sur., A-95 (Big Creek area). Dry. TD 5,732 ft.

Galveston County: Texas Northern Oil Corp. 1 Aralfo, S. F. Austin Sur., A-3. Dry. TD 10,150 ft.

Goliad County: Kirkwood & Co. 1 Kornfuhrer, Peter Glass Sur., A-129. Dry. TD 8,515 ft.

Plymouth Oil Co. 1 Pettus, Southerland, Sur., A-270. Shut down. TD 5,000 ft.

Signal Oil & Gas Co. 1 Haynes, H. T. Callihan Sur., A-80. Dry. TD 7,754 ft. (Extension test Gottschalt field.)

James Doughty 1 Parker, Thomas Wright Sur. Dry. TD 1,810 ft.

Harris County: John B. Coffee and Horace Coon, Jr., 1 Weiman, Charles Scarbrough Sur., A-718. Dry. TD 7,750 ft.

Ivy Minerals Corp. 1 Jacobs, Robert W. Wilson Sur., A-88. IP 83 BOPD, 10/64-in., 39°, casing perforations 9,446-52 ft. TD 9,490 ft. (New field.)

Live Oak County: Chizum, Rhodes & Hicks and W. M. Averill, Jr., 1 McGuffin, J. Poitevent Sur. 277, A-50 (Whittington area). Dry. TD 4,855 ft.

Matagorda County: Jack W. Frazier 1 Kountze & Stewart, I & GN Sur. 8, A-318. Dry. TD 8,595 ft.

Montgomery County: Richardson Oils, Inc., 1 Youens et al, J. R. Cummins Sur., A-140. Dry. TD 5,510 ft.

Newton County: San Jacinto Petroleum Co. 2 Hankamer et al, Nancy Guthrie Sur., A-127. Dry. TD 9,794 ft.

Orange County: Richard M. Wright 1 Sikes, Theron Strong Sur., A-169. IP 14,000 M.c.f. daily, open flow, Frio 8,408-16 ft. (casing perforations). TD 9,222 ft. (Extends Echo field.)

San Jacinto County: Head & Garth 1 Davis, J. S. Brown Sur., A-68. Dry. TD 5,600 ft.

Wharton County: E. J. Hudson 4-A Pierce Ranch, Henry Griffith Sur., A-25. Dry. TD 6,013 ft.

EAST TEXAS

Anderson County: Group Oil Co. et al 1 W. T. Todd, Mark Roberts Sur., A-669. Dry. TD 3,368 ft.

Bowie County: L. A. Grelling 1 Floyd Brady, J. S. Herring Sur., A-263. Dry. TD 5,064 ft.

Cherokee County: D. D. Feldman 1 Ed McDonald, Jose Pineda Sur., A-40. Dry. TD 5,113 ft.

Ellis County: Johnny Mitchell 1 Joe L. Rush, John Chamblee Sur., A-192. Dry. TD 4,061 ft.

Franklin County: Hollandsworth Oil Co. 1 Aldridge, C. H. Simms Sur., A-417. Dry. TD 6,205 ft.

Houston County: W. E. Walker 1 Shepherd, John Childress Sur., A-254. Dry. TD 6,005 ft.

Hunt County: John W. Marshall 1 W. C. Davis, Joel Webb Sur. Dry. TD 2,250 ft.

Kaufman County: Thos D. Humphrey & Sons 1 W. G. Nealy, William Smith Sur., A-444. Dry. TD 5,766 ft. Travis Peak 5,706 ft.

WEST CENTRAL TEXAS

Brown County: Gray Drilling Co. 1 Mrs. Lizzie Thomas, Sec. 141, R. Mitchell Sur. IPP 6 BOPD, sand pay 1,123 ft. TD 1,136 ft.

Callahan County: Butler, Peebles and Halbert 1 A. E. Dyer, Sec. 56, BBB&C Sur. Dry. TD 3,231 ft.

Coleman County: James K. Anderson 1 J. D. Watson, 4-1-J. Thiele Sur. Dry. TD 2,429 ft.

Charles S. Beck 1 Mrs. Mattie Miller, Sec. 3, E. H. Williams Sur. Dry. TD 3,651 ft.

Black, Dorbandt & Ross 1 Earl Ellis, Sec. 494, Pleasant Young Sur. Dry. TD 1,834 ft.

Andre Drilling Co. et al 1 Creswell, 104-2-GH&H. Dry. TD 3,702 ft.

Coronet Oil Co. 1 Morris, Robt. Fitzgerald Sur. 206. Dry. TD 3,000 ft.

G. B. Cree 1-B J. P. Morris, 64-2-GH&H. Dry. TD 2,946 ft.

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Noyes & Nelson 1 W. C. Henderson, 5-168-Asa Wickers Sur. Dry. TD 2,363 ft.

Chas. Rupe Drilling Co. 1 Taylor Morot Co., W. Brockner Sur. Dry. TD 2,404 ft.

Comanche County: Ed R. White 1 W. R. Fleming, E. D. Curbit Sur. Dry. TD 2,907 ft.

Eastland County: Trumter Petroleum Corp. 1 W. S. Carter, 27-1-ETRR. Dry. TD 1,756 ft.

Fisher County: West Central Drilling Co. 1 J. W. Wheeler, G. B. Creath Sur. 221. IP 43.5 BOPD, 26/64-in., 40°, pay 4,710 ft. TD 5,620 ft.

Jones County: Belcher Trust 2 F. G. Keen, Sec. 49, D&DA Sur. IPP 33 BOPD, 39°, pay 2,158 ft. TD 2,210 ft.

Great Lakes Carbon Corp. 2 W. J. Bryant, 15-4-H&TC. Dry. TD 3,800 ft.

Shackelford County: Schkade Bros. Drilling Co. 1 Merrick Davis, 13-12-T&P. Dry. TD 1,504 ft.

Stonewall County: Howsley, Jacobs and Swearinger 1 Gannaway, 301-2-H&TC. Dry. TD 5,949 ft.

A. E. Oldham 1 W. R. Bissett, 21-F-H&TC. Dry TD 6,309 ft., elev. 1,674 ft., Ellenburger 6,232 ft.

Woodson Oil Co. 1 Arthur Brinkley Jr., 13-B-AB&M. IPP 18.5 BOPD, Ellenburger 6,350 ft. TD 6,388 ft.

Taylor County: R. L. Foree 1 Guitar Estate, Sec. 54, BAL Sur. Dry. TD 4,048 ft.

Throckmorton County: Cox Drilling Co. 1 Norton Properties, Blk. 2216, TE&L. Dry. TD 4,795 ft.

Russell Maguire 1 Swenson, Sec. 169, BBB&C Sur. Dry. TD 5,349 ft.

Warren Petroleum Corp. 1 James R. Marshall, Sec. 1686, A-494, TE&L. IP 274 BOPD, 32/64-in., 44°, pay 4,519 ft. TD 4,536 ft.

NORTH TEXAS

Archer County: Osage Exploration Co. 1 Olin Calvin, Horatio Grooms Sur., A-155. Dry. TD 5,308 ft., Mississippian 5,238 ft.

The Texas Co. 15 C. J. Chance, Sec. 12, W. G. Griffin Sur. IP 95 BO in 21 hr., 1-in., 40°, dolomite pay 5,130 ft. TD 5,142 ft.

Baylor County: C. U. Bay 1 Grady England, Sec. 214, T&NO. Dry. TD 4,802 ft.

Clay County: L. T. Burns 1 C. Russell, Blk. 12, A-176, Hopkins CSL. IPP 224 BOPD, pay 4,721 ft. TD 4,740 ft.

Grayson County: Quentin Little 1 W. L. Mullin, Parr Sur., A-972. Dry. TD 7,810 ft., elev. 731 ft., Ellenburger 7,780 ft.

Montague County: Jack Grace Production Co. 1 Brite, TE&L Sur. 2882, A-800. Dry. TD 6,157 ft.

Pontiac Drilling Co. of Texas 2 McNabb Estate, Sec. 14, MEP&P. Dry. TD 5,946 ft.

Wilbarger County: Kouri Oil Co. 1-C McCrary, 64-14-H&TC. Dry. TD 2,022 ft.

Young County: P. C. Brashear 1 Routon, Blk. 24, A-300, TE&L. Dry. TD 725 ft.

Republic Natural Gas Co. 1 Graham Estate, M. Dailey Sur., A-89. Dry. TD 5,059 ft.

C. J. Simpson Drilling Co. 1 M. K. Graham Estate, TE&L Sur. 2915, A-1185. Dry. TD 4,750 ft.

W. C. Wainwright 1 Heard, Sec. 78, TE&L. Dry. TD 1,080 ft.

W. C. Wainwright 1 Scott, Sec. 77, TE&L. Dry. TD 1,065 ft.

WEST TEXAS

Andrews County: Husky Oil Co. 1 Emma Cowden, 1-44-T2N-T&P. IP 142 BOPD, ¾-in., 38°, pay 5,355 ft. TD 5,416 ft.

Borden County: McElroy Ranch Co. 1 Higginbotham, 16-31-T3N-T&P. Dry. TD 9,341 ft., elev. 2,374 ft., Pennsylvanian 7,902 ft., Ellenburger 9,300 ft.

Coke County: F. Kirk Johnson 1 D. F. Perciful, George Kuhlman Sur. 462. Dry. TD 3,841 ft.

Crockett County: Yeatman Drilling Co. et al 1 J. M. Shannon, 34-1-GC&SF. Dry. TD 2,502 ft.

Dawson County: Herrell and Williamson 1 Smart, 111-M-EL&RR. IPP 97 BOPD, 36°, pay 4,912 ft. TD 4,988 ft.

Garza County: Clifton Thomas 1 Honolulu-Sims, Sec. 1282, BS&F, A-652. IPP 111 BOPD, 37°, pay 3,484 ft. TD 3,547 ft.

Howard County: Urice Drilling Co. 1 Rosa Harper, 15-32-T&P. Dry. TD 9,511 ft., elev. 2,616 ft., Pennsylvanian 8,883 ft., Mississippian 9,474 ft.

Irion County: Hill & Meeker 1 Sugg, 21-1-H&TC. Dry. TD 3,427 ft.

Russell Maguire 1 Sugg, 3081-28-GC&SF. Dry. TD 8,407 ft., elev. 2,322 ft., Canyon sand 6,977 ft., Strawn 8,060 ft., Ellenburger 8,175 ft.

King County: Deep Rock Oil Corp. 1 W. R. Ross, 141-A-J. B. Rector Sur. Dry. TD 5,970 ft. Reef 4,394 ft., Strawn 5,180 ft.

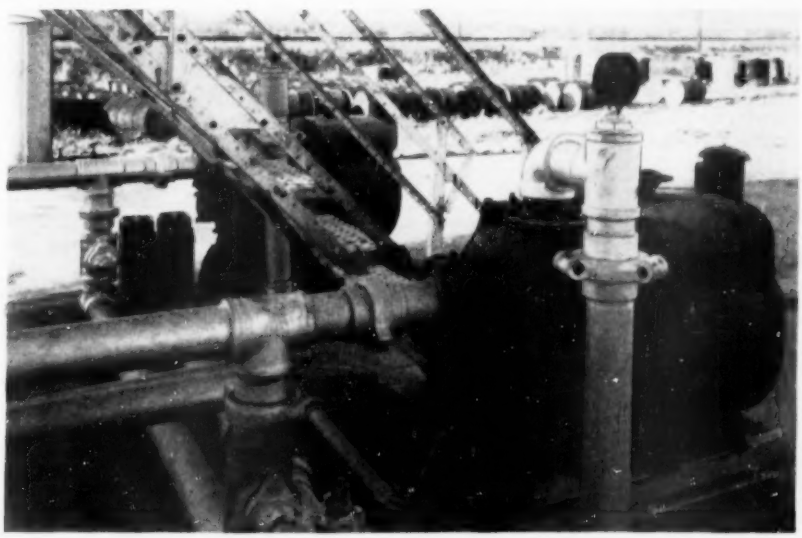
Midland County: Magnolia Petroleum Co. 1 Ida Mae Oldham, 38-37-T1S-T&P. IPP 129.6 BOPD, 43°, Strawn pay top 10,238 ft. TD 10,589 ft.

Reeves County: Great Western Drilling Co. 1 P. G. Northrup, 28-56-T2-T&P. Dry. TD 3,271 ft., elev. 2,087 ft., Delaware sand 3,157 ft.

Runnels County: Murray Petroleum Co. 1 A. R. Workman, G. Bliss Sur. 525. Dry. TD 4,414 ft.

Pumps

. . . . FOR THE OIL INDUSTRY



Two C.M.C. Dual Prime Model 420 Pumps loading lub-oil for Mid-Continent Petroleum Corporation at Odessa, Texas.

Exclusive twin priming advantages give C.M.C. Dual Prime Pumps longer life, minimum maintenance and outstanding operating performance.

They are simple, rugged, fool-proof—and every pump is tested under most severe conditions.

Automatic priming speed on lifts up to 25' is unmatched. Sizes 1½" to 10"—3,000 to 240,000 G.P.H.

Write today for full details — our qualified engineers will gladly help solve your pump problems.

CONSTRUCTION MACHINERY COMPANIES

WATERLOO, IOWA

WILDCAT COMPLETIONS

Schleicher County: C. E. Marsh 1 David, 9-A-GC&SF. Dry. TD 8,600 ft., elev. 2,453 ft., Strawn 7,880 ft., Ellenburger 7,982 ft.

Sterling County: F. L. Wilson 1 Henry Davis, 17-14-SPRR. Dry. TD 1,004 ft.

Sutton County: Ashland Oil & Refining Co. 1 W. D. Wallace, 67-14-TWNG. IP 87 BOPD, 34°, Strawn pay 5,006 ft. TD 6,650 ft., PB 5,037 ft.

Murray Petroleum Co. 1 Miers, Shelby C. Turnage Sur. 78. Dry. TD 5,099 ft., elev. 2,304 ft., Ellenburger 4,915 ft.

Tom Green County: W. C. Kinkel 1 J. E. Hall, Marion Gage Sur. 81. Dry. TD 1,178 ft.

L. E. Scherck 1 Hignett, Sec. 175, H. H. Hornburg Sur. Dry. TD 6,314 ft., elev. 1,840 ft., Strawn 5,126 ft., Ellenburger 5,990 ft.

Upton County: Cities Service Oil Co. 1 University 6-A, 6-14-University Lands. Dry. TD 1,980 ft.

Gulf Oil Corp. 2 McElroy Ranch Co., 182-D-CCSD&RGNG. IP 574 BOPD, ¾-in., 38°, Devonian pay 10,040 ft. TD 10,629 ft. Extension to new field.

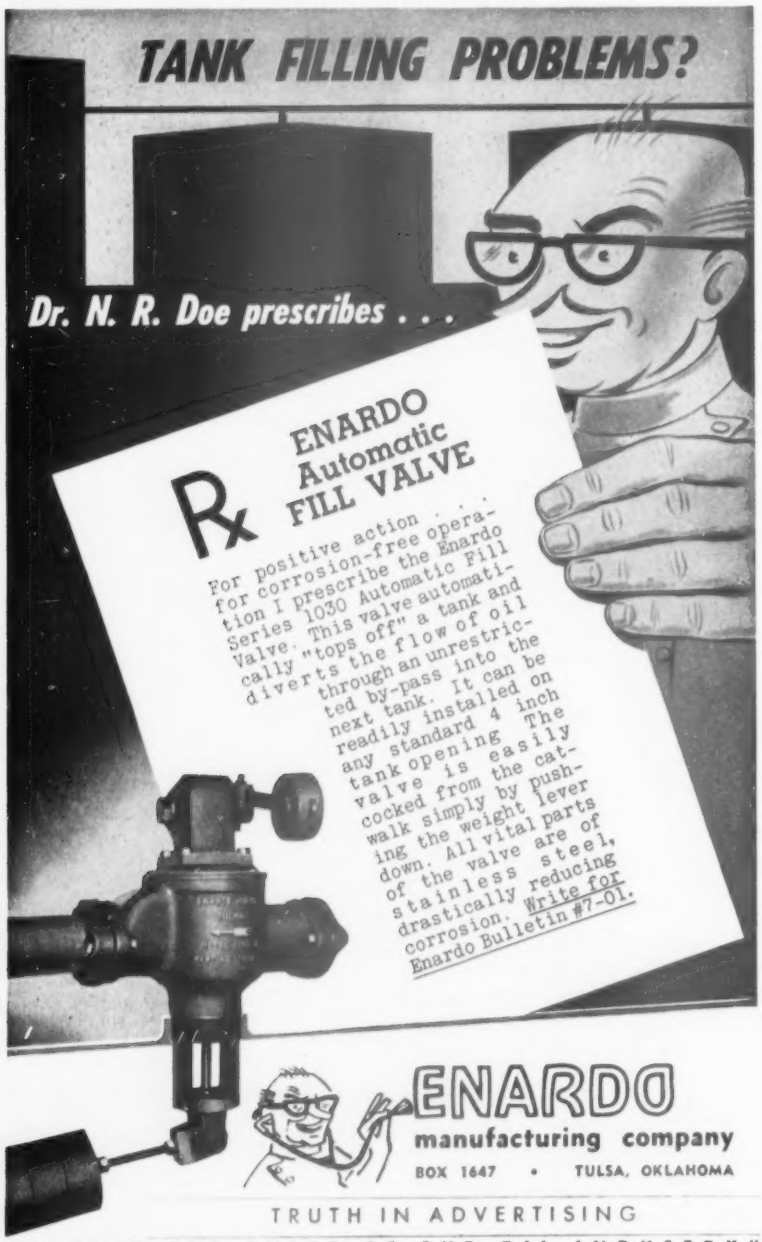
Winkler County: Ralph Lowe 1-D University, 48-21-University Lands. Dry. TD 7,583 ft.

SOUTHEAST NEW MEXICO

Lea County: Union Oil Co. of California 1 Vickers-State, 27-21s-35e. Dry. TD 4,251 ft.

ILLINOIS

Clinton County: G. Gazzarino 1 Moller, SE SE NW 25-2n-1w. Dry. TD 800 ft.


TANK FILLING PROBLEMS?
Dr. N. R. Doe prescribes . . .
Rx
ENARDO
Automatic
FILL VALVE
For positive action . . . for corrosion-free operation I prescribe the Enardo Series 1030 Automatic Fill Valve. This valve automatically "tops off" a tank and diverts the flow of oil through an unrestricted by-pass into the next tank. It can be readily installed on any standard 4 inch tank opening. The valve is easily cocked from the catwalk simply by pushing the weight lever down. All vital parts of the valve are of stainless steel, drastically reducing corrosion. Write for Enardo Bulletin #7-01.
ENARDO
manufacturing company
BOX 1647 • TULSA, OKLAHOMA
TRUTH IN ADVERTISING

Edwards County: Arrow Drilling Co. 1 Peters, SE NE NW 22-2s-10e. Dry. TD 3,340 ft.

Jefferson County: Caltens Bros. 1 Makey, NW SW NE 23-2s-2e. Dry. TD 2,779 ft.

Lawrence County: John Zanetis 1 Garhart, SW SE SW 29-4n-10w. Dry. TD 2,207 ft.

Washington County: Slagter Production Co. 1 Meyer, NW NW SW 5-2s-3w. Dry. TD 2,700 ft.

INDIANA

Dubois County: H. A. Johnson 1 Erick, SE SE SE 20-3s-5w. Dry. TD 1,160 ft.

G. G. Fisher 1 Jackson, SE NE SW 14-2s-6w. Dry. TD 1,136 ft.

J. H. Gilliam 1 Small, NW SW NW 6-2s-5w. Dry. TD 1,048 ft.

Gibson County: Ryan & Shark 1 Brasselton, NE NW NE 15-2s-12w. Dry. TD 2,883 ft.

Spencer County: W. Addington 1 Billingsley, NE SW SE 23-6s-5w. Dry. TD 1,218 ft.

Sullivan County: B. Hackbush 1 Bohanon, NW SE SW 24-9n-10w. Dry. TD 1,045 ft.

Vigo County: Great Lakes Carbon Co. 1 Weld, SW SW SW 22-11n-10w. Dry. TD 1,230 ft.

C. O. Turner 1 Nunn, NW NE NW 27-11n-8w. Dry. TD 1,863 ft.

KENTUCKY

Henderson County: Ashland Oil & Refining Co. 1 Reynolds, NE SW NE 9-Q-25. Dry. TD 2,300 ft.

R. E. Hupp 1 Porgeson, NE SE SW 15-Q-26. Dry. TD 2,171 ft.

Eable & Holder 1 Gingel, SE NW SE 24-P-25. Dry. TD 2,505 ft.

MICHIGAN

Allegan County: R. D. Evans & Sons 1 Garlock, NE NE NW 2-2n-13w. Traverse 1,550 ft., 10 bbl. after acid, TD 1,557 ft.

Allegan County: Cook Drilling Co. B-5 U.S.A., SW SW SW 21-2n-14w. Dry. TD 1,352 ft. in Traverse lime.

Arenac County: Voorhees Drilling Co. 1 Yawkey, SE NE SE 20-18n-4e. Dry. TD 3,035 ft. in Dundee.

Branch County: Carter Oil Co. 1 Pierce & Fowler, SE SW SE 10-7s-7w. Dry. TD 2,229 ft. in Niagaran.

Cass County: Norman L. Stevens 1 Compton, SW NW SW 5-5s-13w. Dry. TD 1,162 ft. in Traverse lime.

Cass County: D. B. K. Van Raalte 1 Simmons-Poe Comm., SW SE SE 15-6s-13w. Dry. TD 1,143 ft. in Traverse lime.

Hillsdale County: Pure Oil Co. A-1 Moshier, SE SE NW 21-8s-3w. Dry. TD 980 ft. in Traverse lime.

OHIO

Coshocton County, Jackson Township: B. G. Davis et al 1 C. A. Wallick, 2nd Qr., 330 M.c.f. daily. TD 4,000 ft. (New pool.)

Huron County: McManaway et al 1 Curt Klein, Lot 4-95. Dry. TD 3,321 ft. St. Peters.

FLORIDA

Calhoun County: A. R. Temple 1 Neal, C SW NE 33-1n-10w. Dry. TD 4,597 ft. Elev. 152 ft., Chalk 2,780 ft., marine Tuscaloosa 3,980 ft., lower Tuscaloosa 4,249 ft., lower Cretaceous 4,577 ft.

Santa Rosa County: Florida Service Corp. and Clinch Drilling Co. 1 U.S.A., NE SW SE 8-5n-26w. Dry. TD 6,500 ft. Elev. 187 ft., Chalk 3,170 ft., Eutaw 4,660 ft., marine Tuscaloosa 5,364 ft., Massive 5,792 ft., lower Cretaceous 6,020 ft.

ALABAMA

Escambia County: Durbin Bond & Co. 1 Huxford, C SW SW 11-2n-9e. Dry. TD

CROSSETT CHEMICAL COMPANY

Announces APPOINTMENT of DISTRIBUTOR for

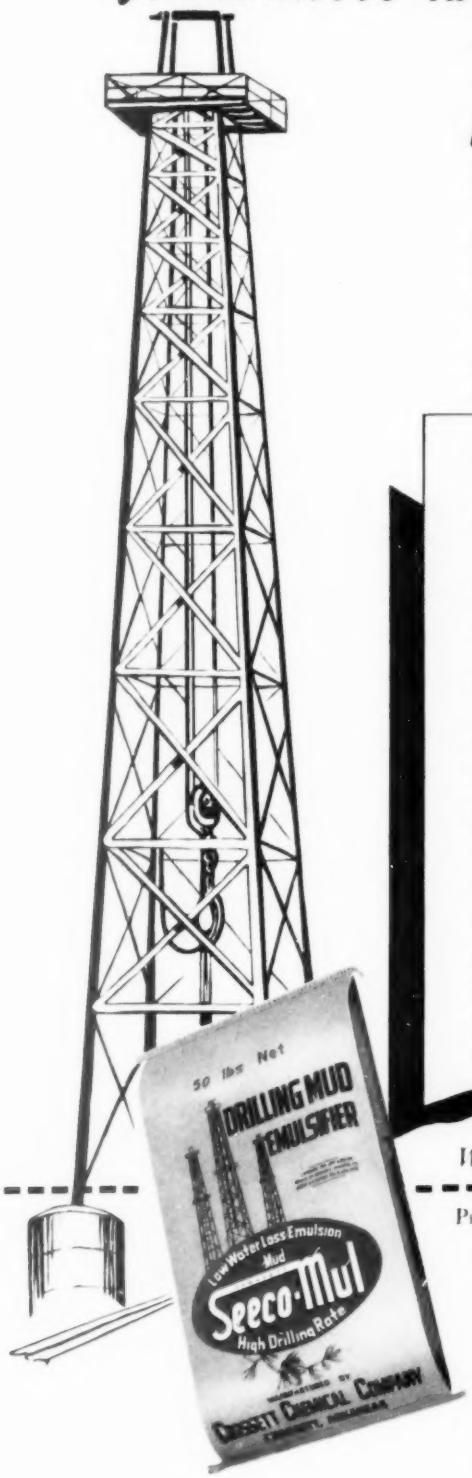
CROSSETT

Seeco-Mul

Outstanding Drilling Mud Product

Drilling mud service companies will be interested to learn that they can now get supplies of Crossett's drilling mud emulsifier from Products Development Company of Houston, Texas.

This outstanding product is Seeco-Mul, a floating soap in dried powder form, consisting primarily of the sodium salts of abietic, linoleic and oleic acids with appreciable quantities of wood tannins and lignins, which give Seeco-Mul some of its unusual properties.



HERE'S WHAT USE IN OVER 300 WELLS HAS PROVED ABOUT SEECO-MUL!

INCREASED DRILLING RATE MADE POSSIBLE
Seeco-Mul added to mud containing oil has increased drilling rate up to 100%.

SEECO-MUL IMPROVED HOLE CONDITIONS
Forms tougher and thinner wall cakes.
Reduces drill stem torque.
Tightens the emulsion and retards sloughing.

LOW FILTRATE LOSS IN EMULSION MUDS FOUND
A. P. I. water losses reduced to as low as 1 cc per 30 minutes.

PRODUCES LOW INTERFACIAL TENSIONS
Filtrates from typical SEECO-MUL muds have a surface tension in the order of 35 dynes per centimeter.

PRODUCES LOW VISCOSITY MUDS
Seeco-Mul has been used as a thinner when other materials have ceased to function.

SEECO-MUL IS TEMPERATURE STABLE
The use of Seeco-Mul at elevated temperature and pressures resulted in lower water losses.

SIMPLE AND EASY TO USE
No special technique is required for the use of Seeco-Mul.
It has been used successfully to form crude oil emulsions; it is readily soluble in cold water or directly in the mud; it is non-fermenting, non-staining and non-toxic. Seeco-Mul is conveniently packed in 50-pound bags.

Write for Samples and Additional Information Today!

Products Development Co. 4207 Polk Avenue, Houston, Texas

Attention: Mr. Roy Dawson. Please send me at once

- ☐ Descriptive literature about SEECO-MUL.
- ☐ Sample of SEECO-MUL for my laboratory evaluation.

SIGNED _____

FIRM NAME _____

ADDRESS _____

CITY _____ STATE _____

Another of 15 reasons why

Advanced design. The list of **REED** tool joint developments is assurance that **REED** Tool Joints contain all the latest improvements in design.

Chemical analysis of every heat of steel is checked by spectrograph.

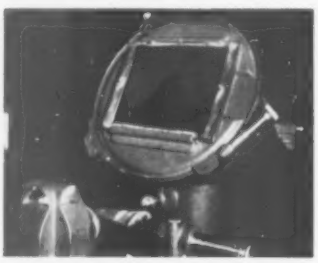
Strength and toughness of every heat of steel are determined by three different testing machines.

Grain structure and grain flow are checked by microscope. **REED** Tool Joints meet the very highest standards.

Hardenability tests are made and form the basis for the "tailored" heat treatment of tool joints made from different heats of steel.

Precision machining is accomplished by specially designed automatic machines.

Jigs and fixtures of the highest precision assure perfect alignment and concentricity of **REED** Tool Joints.



Thread comparator checks hob used to cut **REED** Tool Joint threads, assuring accuracy of thread form, lead and taper.

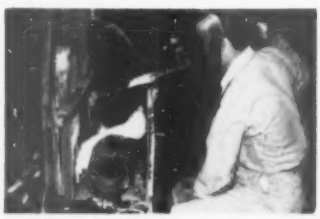
Automatic heat treating furnaces—especially designed for the job—heat tool joints to utmost precision in a carefully controlled atmosphere.

This central control room enables the heat treat foreman to "tailor" the treatment of each heat of steel to extreme accuracy.

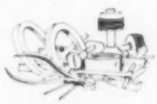
Precision quenching and drawing complete the "tailored" heat treatment that gives the best combination of strength and toughness to every tool joint.

Hardness testing is final assurance that every **REED** Tool Joint is strong and tough.

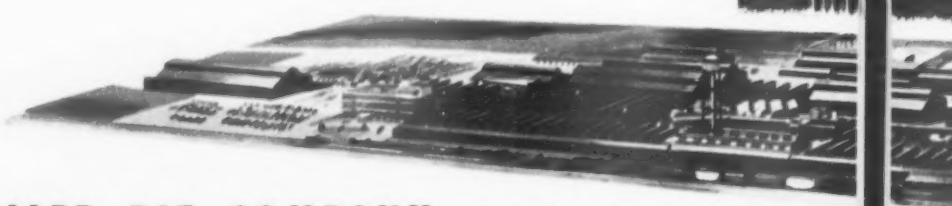
Tool joint threads are treated to prevent galling during breaking-in. Complex metal phosphate coating acts as a pre-lubricant infused into the threads.



"Reedite" hard facing—available on order—is factory applied to resist abrasion better and make tool joints last longer.



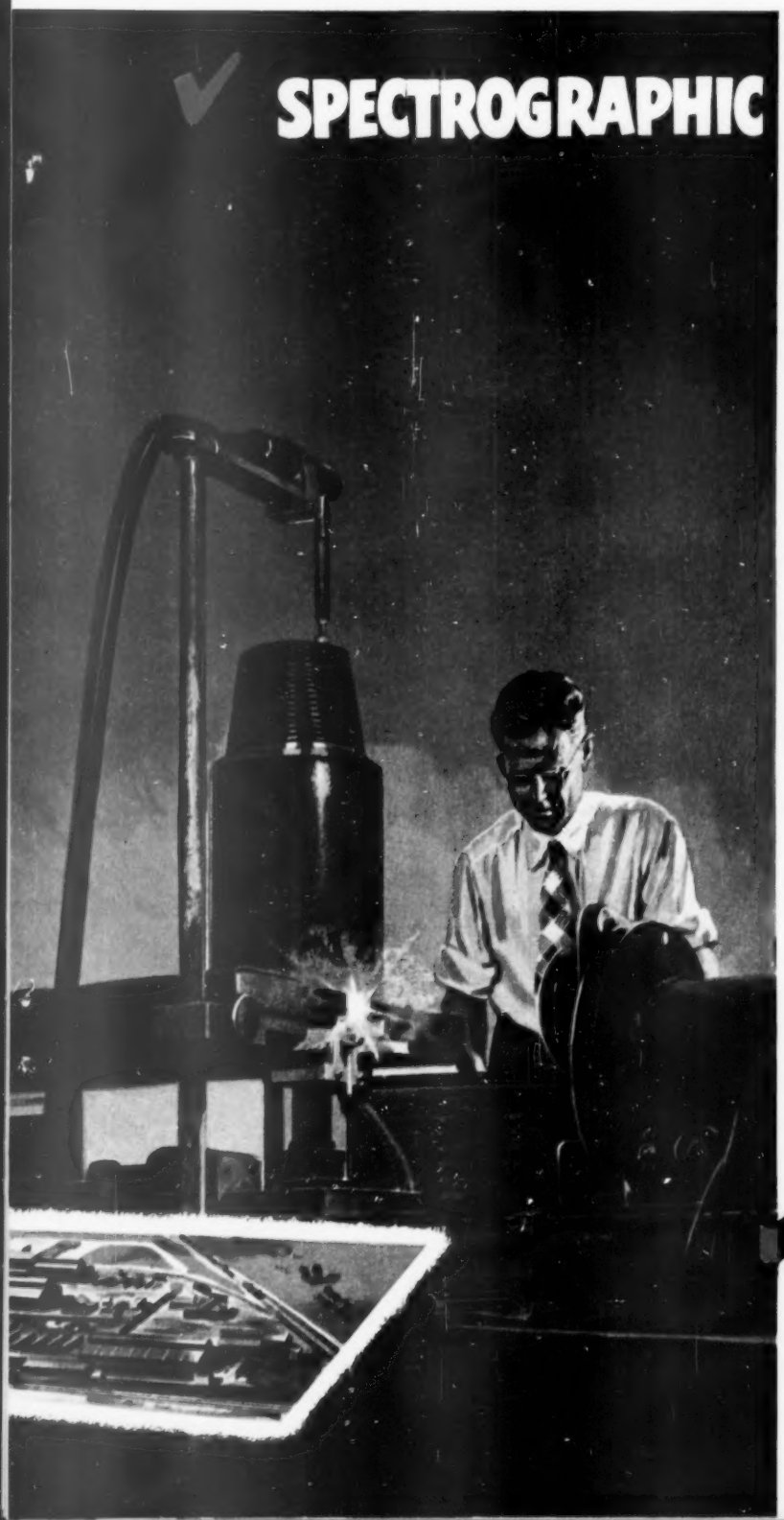
These hand gauges, plus comparators, master gauges, profilimeters, magnaflux and other machines, are used to make the 120 inspections each tool joint must pass.



REED ROLLER BIT COMPANY HOUSTON 1, TEXAS

NEW YORK • LONDON • BUENOS AIRES

REED tool joints last longer!



SPECTROGRAPHIC ANALYSIS

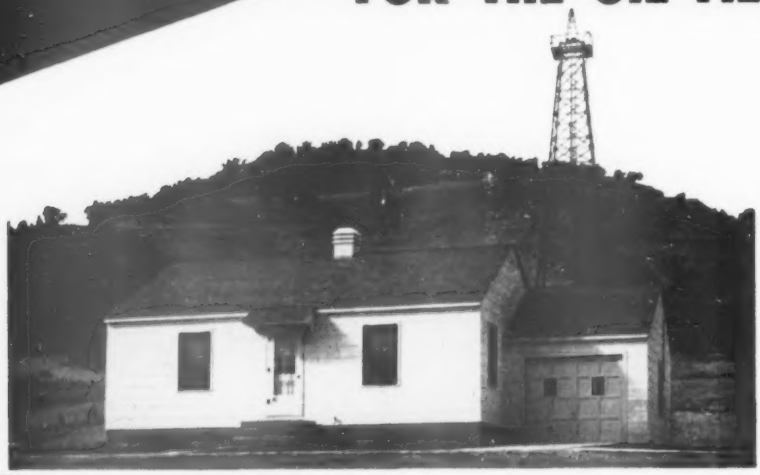
This spectrograph is being used to determine the chemical analysis of the steel in a **REED** Tool Joint. This inspection is important to you because it assists **REED** metallurgists in "tailoring" heat treatment to each batch of steel. This "tailored" heat treatment gives every **REED** Tool Joint the right balance between strength and toughness.

This spectrographic analysis is just one of the many important reasons why **REED** Tool Joints last longer.

R

THE MARK OF QUALITY

WHY STURDYBILT PREFABRICATED HOUSES FOR THE OIL FIELDS?



STURDYBILT Houses have ALL the advantages of conventional houses, and NONE of the disadvantages. STURDYBILT Houses are weather-tight, constructed to last, and are roomy, comfortable and beautifully designed.

STURDYBILT Houses, because they are prefabricated at the factory, can be moved to any site, erected in days instead of weeks or months, and are easily taken down and transported to another location with little or no loss of material.

Investigate STURDYBILT Prefabricated Demountable Houses today.

MANUFACTURERS OF SPECIAL MILLWORK, DISTRIBUTORS OF JOHNS-MANVILLE BUILDING MATERIALS; CURTIS WOODWORK

STURDYBILT

PREFABRICATED, DEMOUNTABLE HOUSES

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PREFABRICATED HOME MANUFACTURERS INSTITUTE phmi

STURDYBILT HOUSES COMPLY WITH COMMERCIAL STANDARD CS125 OF THE NATIONAL BUREAU OF STANDARDS FOR PREFABRICATED HOMES

WILDCAT COMPLETIONS

6,215 ft. Elev. 246 ft., first Eutaw sand 4,568 ft., marine Tuscaloosa 5,370 ft., Massive 5,763 ft., lower Cretaceous 5,995 ft.

Monroe County: Sunnyland Contracting Co. 1 Gillard, SW SE 31-10n-7e. Dry. TD 4,552 ft. Elev. 222 ft., Chalk 1,136 ft., Eutaw 2,329 ft., marine Tuscaloosa 3,505 ft., lower Tuscaloosa 3,601 ft., lower Cretaceous 3,913 ft.

MISSISSIPPI

Carroll County: N. B. Hunt 1 Winters, SE SE 28-18n-3e. Dry. TD 5,961 ft. Elev. 398 ft., Chalk 2,580 ft., Eagleford 3,501 ft., Tuscaloosa 4,120 ft.

Claiborne County: Crow Drilling Co. 1 Patton et al, 38-12n-4e. Dry. TD 6,539 ft. Elev. 189 ft., Wilcox 3,597 ft.

Hancock County: Sun Oil Co. 2 International-Alexander, 17-9s-17w. Dry. TD 9,854 ft.

Jefferson County: Kirby Petroleum Co. 1 Truly, 72-9n-1w. Dry. TD 6,604 ft. Elev. 309 ft., Sparta 2,598 ft., Wilcox 3,913 ft., base Big shale 5,264 ft., Artman 5,602 ft.

Wayne County: The Texas Co. 1 Morgan, 7-10n-6w. Dry. TD 9,797 ft. Elev. 273 ft., marine Tuscaloosa 5,580 ft., Massive 5,912 ft., lower Cretaceous 6,127 ft., Glen Rose 8,400 ft.

SOUTH LOUISIANA

Acadia Parish: Kirby Petroleum Co. 1 Gaston Cart et al, Unit 1, 8-8s-1w. Dry. TD 9,852 ft.

Allen Parish: Magnolia Petroleum Co. 1-F Long Bell, 5-6s-7w. Dry. TD 9,529 ft.

Livingston Parish: A. J. Bankhead et al 1 Bond, 32-7s-3e. Dry. TD 9,518 ft.

Plaquemines Parish: Gulf Refining Co. 1 State Lease "QQ" 195, Township 17s-17e, East Black Bay. IP 162 BOPD, 9/64-in., 29.4°, casing perforations 7,714-27 ft. TD 11,500 ft. (New field.)

Vernon Parish: Sunray Oil Corp. 1 Fletcher estate, 3-2s-9w. Dry. TD 11,468 ft.

NORTH LOUISIANA

Catahoula Parish: W. H. Bryant et al 1 International Paper Co., C SE NE 25-10n-5e. Dry. TD 5,275 ft. Wilcox 2,811 ft.

Concordia Parish: Hunt and Gulf 8 Angelina Hardwood "C," C SW SE 21-5n-8e. Dry. TD 7,204 ft. Base Nebo 5,906 ft.

ARKANSAS

Columbia County: Trans-Tex Drilling Co. 1 Dennis, 410 ft. S and 990 ft. W of NEc 12-16s-22w. Dry. TD 7,253 ft.

Howard County: J. R. Bondurant et al 1 Westfall, C NE NW NW 1-8s-27w. Dry. TD 302 ft.

Monroe County: Seaboard Oil Corp. S-2 Core Test, C S½ SE SW SE 12-4n-3w. Dry. TD 2,335 ft.

Union County: Curtis A. Kinard et al 1 First National Bank, 330 ft. N and 673 ft. E of SWc NW NE 11-18s-17w. Dry. TD 3,118 ft.

Kinard et al 1 Brewster, C NW NE 23-17s-16w. IPF 223 BOPD, Smackover 6,733-39 ft., 18/64-in., 37.4°. TD 6,838 ft. (New pay at East Lisbon field.)

OKLAHOMA

Cimarron County: Coltexo Corp. 1 Purdy "E," NW NW SE 17-6n-9eCM. IPP 36 BOPD, 4,320-37 ft. 39°. TD 4,715 ft.

Coltexo 1 Purdy "D," C NW SE 29-6n-9eCM. IP 1,000 M.c.f. of gas per day, Morrow 4,106 ft. TD 4,820 ft.

Creek County: W. B. Moran 1 Willis, NE SW SE 33-14n-9e. Dry. TD 3,804 ft.

Grant County: The Texas Co. 1 McMahan, NW NE NE 17-26n-3w. Dry. TD 5,660 ft.

Lincoln County: K. A. Ellison 1 Hon, NW NW SW 32-13n-3e. Dry. TD 5,661 ft.

Logan County: Walter Duncan 1 Downey, SE SW NE 11-16n-1e. Dry. TD 5,103 ft.

The Texas Co. 1 State Land "R," NE NE SW 16-16n-1e. Dry. TD 5,103 ft.

Okfuskee County: Frank G. Weimer 1 Fife, NE NE SE 5-12n-7e. Dry. TD 3,405 ft.

Payne County: S. C. Yingling 1 Swart, NW NE NE 32-20n-2e. IP 720 BOPD, Simpson 4,724-33 ft. 40°. TD 4,733 ft. (Oil discovery.)

Pontotoc County: Unioco Oil Co. 1 Moon, NE SW SW 9-1n-7e. Dry. TD 2,516 ft.

S. M. Boyd, Sr. 1 Norbean, SW SE NE 22-2n-5e. Dry. TD 1,602 ft.

Pem-Wes Oil Co. 1 Barney, C SW SW 21-4n-5e. Dry. TD 2,137 ft.

Pottawatomie County: Anchor Petroleum Co. 1 Neal et al, SW NW SE 34-8n-2e. Dry. TD 5,924 ft.

KANSAS

Barber County: Beardmore 1 Phye, NWc 25-31s-12w. Dry. TD 4,385 ft.

Butler County: Champlin Refining Co. 1 Janzen, SW SW NE 35-23s-5e. Dry. TD 2,681 ft.

Cowley County: Trueway Oil 1 Wakefield, NE SW SW 17-30s-6e. Dry. TD 2,922 ft.

Ellis County: Braden Drilling Co. 1 Gerken, SWc 13-13s-20w. Dry. TD 3,900 ft.

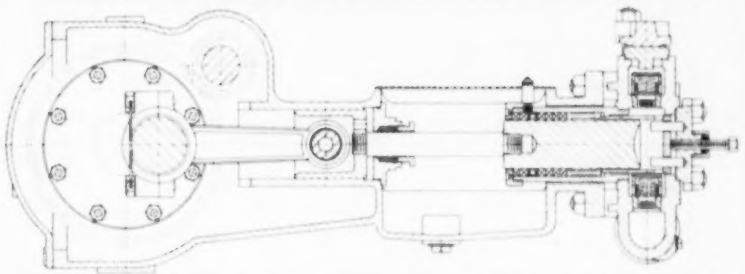
Hodgeman County: Atlantic-Carter 1 Mooney, SW SW 20-22s-21w. Dry. TD 4,895 ft.

Lyon County: White & Ellis 1 Lamoureux, SE NE SW 26-21s-10e. Dry. TD 2,600 ft.

A New Improved Triplex Pump

POWERED By An *Air-Cooled* HEAVY DUTY

WISCONSIN ENGINE



For 1,000 lbs.—Built in two sizes: 30 and 50 B.P.H.

FEATURES:

1. Fluid end made of corrosion resistant bronze and stainless steel fitted.

2. Internal heavy constructed reduction gears operating in an oil bath with shafts on large Timken bearings. Suitable for 1800 RPM prime mover.

3. Outside packed.

4. Valve covers yoke type, held in place by stud bolts. Can be removed unlimited number of times without any wear to fluid end or danger of leakage.

5. Adjustable piston glands with conventional packing on power end that eliminates contamination of lubricating oil.

POWER:

Units fully fabricated with WISCONSIN Air Cooled HEAVY DUTY ENGINES.

SERVICE:

For high pressure crude (sweet or sour) gathering pumps, salt water disposal, pilot flood, station sump pumps and many special problems.

Made by a pump manufacturer with 73 years' experience to our specifications backed by our 35 years' experience in every day oil field problems. Simple in design, easy to service, economical to operate—it is built for rugged duty, and as near precision as practical, every day oil field operation will permit.

Complete stocks of service parts available for immediate shipment.

HARLEY SALES CO.

M&M Bldg. HOUSTON | P. O. Box 1259 TULSA | 505 S. Main WICHITA

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Please send me information and application for

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Address_____

WILDCAT COMPLETIONS

Marion County: E. B. Shawver 1 Demand, SW NE SW 6-20s-4e. Dry. TD 2,516 ft.

McPherson County: Anschutz Drilling Co. 1 Schrag, SE SE NE 27-19s-4w. Dry. TD 3,830 ft.

Norton County: Sauvage & Dunn 1 Collins, SE SW SW 6-3s-24w. Dry. TD 3,786 ft.

Empire Drilling Co. 1 Troule, SWc 20-4s-22w. Dry. TD 3,764 ft.

Pawnee County: Morrison Drilling Co. 1 Harper, SE NE SE 4-20s-18w. Dry. TD 4,076 ft.

Vickers Exploration 1 Sweeney, NW NW NE 8-21s-15w. IP 6,160 M.c.f. of gas per day, Arbuckle 3,792-3,801 ft. TD 3,818 ft. (Gas discovery.)

Pratt County: GMR 1 Smith, SW SW NE 8-28s-13w. Dry. TD 4,548 ft.

Rooks County: Musgrove 1 Shepherd, SEc 22-10s-18w. Dry. TD 3,685 ft.

Trans-Era 1 Kriley, SW SW NE 22-8s-18w. Dry. TD 3,432 ft.

Rush County: Toklan Production 1 Felder, SE SE NE 30-18s-19w. Dry. TD 4,207 ft.

Bennett & Roberts 1 Bott, SW SW NE 11-18s-20w. Dry. TD 4,230 ft.

Musgrove 1 Shiney, NEc 12-19s-19w. Dry. TD 4,008 ft.

Sedgwick County: C. L. Carlock 1 Nickles, SW SW SE 19-2s-2e. IPP 20 BOPD, Burgess sand 3,007-10 ft. TD 3,010 ft. (Oil discovery.)

NORTHERN NEW MEXICO

Rio Arriba County: Phillips Petroleum Co. 1-14 Mesa unit, SW NE NE 14-28n-6w. IP 3,210 M.c.f. of gas per day. Pt. Lookout 5,483 ft. TD 5,703 ft. (Gas discovery.)

Skelly Oil Co. 1 Hickman, NE SW NE 17-28n-6w. IP 4,640 M.c.f. of gas in 3 hours. Pt. Lookout 5,776 ft. TD 5,930 ft.

NEBRASKA

Cheyenne County: Gilliam Drilling Co. 1 Johnson, NE NW NE 30-15n-47w. Dry. TD 4,530 ft.

Kearney County: K&E Drilling Co. 1 Swanson, NE NE NE 32-8n-16w. Dry. TD 4,194 ft. Arbuckle 4,140 ft.

Red Willow County: Sauvage & Dunn 1 Reiners, SE SE NW 23-4n-28w. Dry. TD 3,567 ft.

NORTH DAKOTA

Renville County: Sohio Petroleum Co. 1 Nelson, C SE SW 34-158n-81w. Dry. TD 4,954 ft. Lodgepole 4,866 ft.

CALIFORNIA

Alameda County: The Texas Co. 1 Wagoner, 19-3s-2e. Dry. TD 9,228 ft.

Colusa County: Humble Oil & Refining Co. 1-B Capital Co., 3-16n-1w. Dry. TD 10,133 ft.

Kern County: B. C. Mackey 1 C.S.F., 34-27s-19e. Dry. TD 1,973 ft.

M J M & M Oil Co. et al 1 Blackburn, 19-39s-29e. Dry. Deepened from 5,165 ft. to 8,249 ft.

Sunset Oil Co. 88 Sunset-Tejon, 11-11n-18w. Dry. TD 1,022 ft.

Union Oil Co. 86-9 Kernco, 9-30s-28e. Dry. TD 9,645 ft.

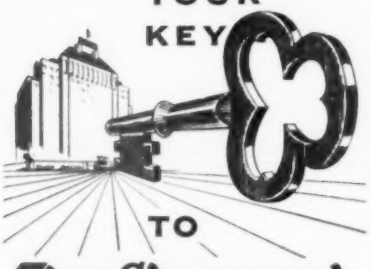
Kings County: Franco Western Oil Corp. 42-A Norris Orchard, 33-24s-18e. Dry. TD 1,270 ft.

Los Angeles County: Standard Oil Co. of California 1 Coffman, 18-2n-15w. Dry. TD 6,608 ft.

Madera County: Trico Oil & Gas Co. 2 Howard, 36-11s-14e. Dry. TD 4,400 ft.

Merced County: Richfield Oil Corp. 54-34 Fancher, 34-7s-14e. Dry. TD 4,110 ft.

HERE'S YOUR KEY



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WILDCAT COMPLETIONS

Orange County: Shell Oil Co. 1 Keeler Comm., 6-3s-9w. Dry. TD 8,104 ft.

San Joaquin County: James Fischgrund-Monarch Oil Co. 1 E. W. Woods, 26-1n-5e. Dry. McDonald sand 5,324 ft., TD 5,337 ft.

Santa Barbara County: R. C. Turnbull 4 Barham-Schmitz, 12-7n-32w. Dry. Re-drilled from 2,427 to 4,933 ft.

Union Oil Co. 75-4 Jesus Maria, 4-8n-35w. Dry. TD 2,426 ft.

Wilrich Development Co. 1 Richardson, 13-10n-28w. Dry. Cretaceous 1,297 ft., TD 1,393 ft.

Tulare County: Sequoia Oil & Gas Co. 1 Phillips - Sequoia, 32-23s-24e. Dry. TD 3,843 ft.

Ventura County: Pamoan Oil Co. 1 Hot Rod Flannagan, 6-2n-17w. Dry. TD 3,200 ft.

MONTANA

Petroleum County: Ike Taylor et al 1 King Paterson, SE NE NW 3-13n-26e. Dry. TD 1,308 ft.

Rosebud County: Coden Exploration 1 Nefsy-Thompson, C NW SW 34-11n-42e. Dry. TD 8,863 ft.

Roosevelt County: Ajax Oil-Carrol J. Kirk 1 Howey, C NE NW 9-29n-51e. Dry. TD 1,342 ft.

WYOMING

Carbon County: Sinclair Oil & Gas Co. 1 SE SE SW 24-20n-88w. Dry. TD 7,657 ft. Embar 7,186 ft.

Crook County: Petroleum Exploration 2 Barton, NW NW NW 31-50n-76w. IPP 50 BOPD, Muddy 1,652 ft. TD 1,671 ft. (Muddy discovery, new field.)

UTAH

Sevier County: El Paso Natural Gas Co. 1 Unit, SW NE NE 15-22s-2e(SLM). Dry. TD 6,117 ft. Morrison 6,015 ft.

Uintah County: El Paso 1 Unit, C SE SE 1-14s-18e. Dry. TD 5,515 ft. Mesaverde 5,455 ft.

COLORADO

Logan County: Ryan Oil Co. 1 Ziegler, C NW NE 30-10n-53w. Dry. TD 5,207 ft.

Moffat County: Anderson-Prichard Oil Corp. 1 Government "A," SE SE NE 17-4n-95w. IPF 173 BOPD, 2½-in. tubing, Morrison. TD 6,330 ft. (Morrison discovery.)

Rio Blanco County: The California Co. Oil Group, Ltd., 1 Government, NE SE NE 34-3n-103w. Temp. abd. TD 3,728 ft.

Weld County: Shell Oil Co. 1 Wilson, C SE SW 20-7n-59w. Dry. TD 8,354 ft. Big Blue 8,248 ft.

SASKATCHEWAN

Tide Water Atlas 3 Crown, LSD 8, 20-18-14w3. Dry. TD 3,470 ft.

Socony-Woodley-Southern 36-4 South Bestville, LSD 4, 36-16-22w3. Dry. TD 3,236 ft.

Shell A-1-4 Minard, LSD 1, 4-5-7w2. Dry. TD 5,115 ft.

Amurex Albercan 1-7 Eremenko, LSD 7, 17-10-28w3. Dry. TD 4,275 ft.

Canadian Delhi et al 1 Cypress Hills, LSD 9, 9-6-30w3. Dry. TD 4,770 ft.

Baysel 14-35 Forget, LSD 14, 35-8-7w2. Dry. TD 4,004 ft.

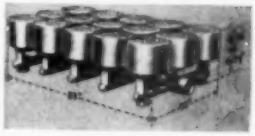
Williston-Bobjo 1-19 Forget, LSD 1, 19-9-6w2. Madison oil well. TD 3,991 ft.

British American-Husky-Phillips 1 Lemberg, LSD 9, 11-20-9w2. Dry. TD 2,508 ft.

British American-Williston 1 Riceton, LSD 4, 29-13-17w2. Dry. TD 3,505 ft.

Delhi-Husky-Phillips 1 Rock Creek, LSD 2, 4-10-19w3. Dry. TD 4,940 ft.

"Blue Flame"



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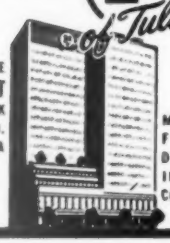

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TEL. 236

WILDCAT COMPLETIONS

British American-Husky-Phillips 1 Tyvan, LSD 9, 11-13-13w2. Dry. TD 3,812 ft.
Tide Water-Wishart 1 Crown, LSD 13, 21-30-13w2. Dry. TD 2,039 ft.
Shell 9 Wood Mountain, LSD 14, 9-1-8w3. Dry. TD 4,785 ft.

ALBERTA

Dome J. V. 10-24 Consort, LSD 10, 24-36-7w4. Viking sand gas well. TD 2,685 ft.
Imperial-Central-Del Rio 6-31 Sarepta, LSD 6, 31-49-21w4. Dry. TD 5,496 Sinclair 1 Sunnynook, LSD 15, 29-27-11w4. Dry. TD 4,300 ft.

BRITISH COLUMBIA

Gulf States-Fargo 1 Gundy Creek, unsurveyed territory. Dry. TD 4,211 ft.

NORTHWEST TERRITORIES

British American-Hudson's Bay 1 Lone Mountain, unsurveyed territory. Dry. TD 2,645 ft.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that approximately 1,815 acres of land in T. 29 N., Rs. 12 W. and 13 W., and T. 30 N., R. 6 W., N.M.P.M., within the known geologic structure of the San Juan field, New Mexico, will be offered in 7 parcels for oil and gas leasing through competitive bidding to the qualified bidders of the highest cash amounts per acre at 1 p.m., Eastern Standard time, October 14, 1953, when bids will be opened. Details of the lease offering, how and where to submit bids, and a description of the lands may be obtained upon request from the Manager of the Land and Survey Office, Santa Fe, New Mexico, or from the Bureau's Washington office. L. E. Hoffman, Chief, Division of Minerals.

EQUIPMENT MEN

Noebels Heads Beckman Applications Division

H. J. NOEBELS

Appointment of Henry J. Noebels to head the applications engineering division of Beckman Instruments, Inc., has been announced by William H. Steinkamp, vice president and general sales manager.

Noebels has been associated for the past 8 years with Heyeden Chemical Co., Garfield, N. J., in charge of the physical instrumental analytical research laboratory. He worked also during this period as adjunct-professor of analytical instrumentation at the Newark, N. J., College of Engineering.

Kohlman Is Named to New Post by American Cyanamid

Appointment of Clem W. Kohlman as advertising manager of the industrial chemicals division of American Cyanamid Co., effective September 1, has been announced by Richard E. Sumner, general manager of the division.

In his new post, Kohlman, who previously directed advertising and sales promotion for the Textile Resin Department of American Cyanamid, will be in charge of advertising and sales promotion for the six departments in the industrial chemicals division.

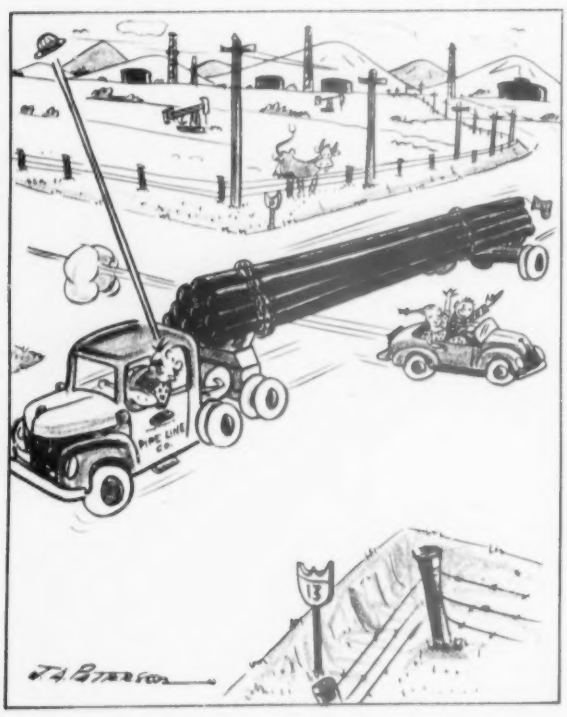
A. M. Asherman will be assistant advertising manager of the division.

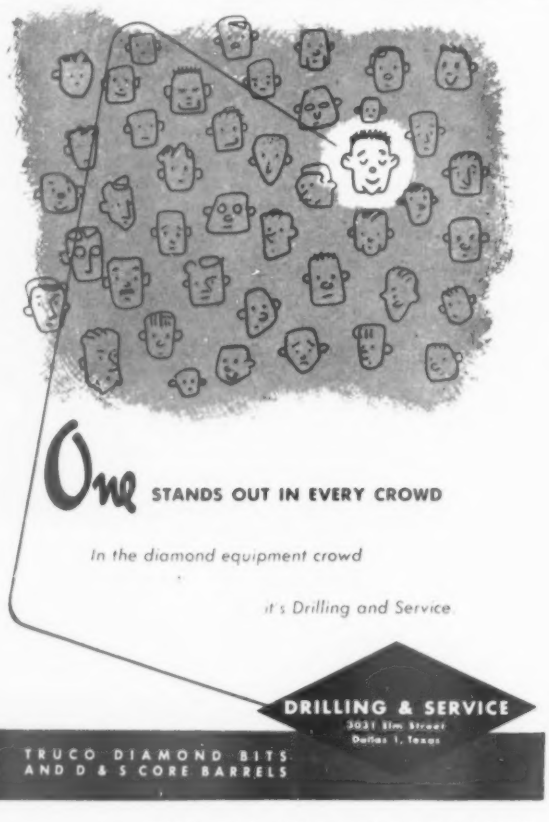
St. Thomas Is Promoted By Carboloy Department

Charles E. St. Thomas has been named manager, advertising and sales promotion at the Carboloy department of General Electric Co., according to an announcement by J. E. Weldy, manager of marketing.

St. Thomas had been news bureau manager since August 1952 when he joined the Carboloy department. Prior to that time he was with the general news bureau of General Electric in Schenectady, N. Y.

St. Thomas is filling a post formerly held by E. C. Howell, recently deceased.

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Dowell Opens District Office in Denver, Colo.

E. H. NIELSEN

The expansion program begun by Dowell Incorporated in the Rocky Mountain region nearly 3 years ago now includes the organization of its Denver district. The announcement of the new district was made by A. C. Polk, Jr., general manager at Tulsa.

States included in the Denver district are Montana, North and South Dakota, Wyoming, Colorado, Utah, and northern New Mexico. All the activities of the company in this rapidly growing area will be directed from the Denver office.

Dowell's service and products are available at Williston and Tioga, N. D.; Glendive, Mont.; Worland, Wyo.; Sterling, Colo.; Vernal, Utah, and Aztec, N. M. Sales offices are located in Denver, Casper, and Billings, Mont.

The new district will be managed by Emery H. Nielsen, formerly assistant manager at Wichita. Nielsen has been with Dowell since 1944, and has been located in Denver since 1952.

William J. Buehler has been transferred to Denver as district office manager. He has been a member of the Tulsa general office since 1945, and for the past 2 years has been billing supervisor.

Other key men who will assist Nielsen in the district operation will be Alfred Gionta, area engineer, Casper; J. A. McClure, area engineer, Williston, N. D.; W. C. Gibbs, sales engineer, Sterling, and H. A. Riggs, sales engineer, Vernal.

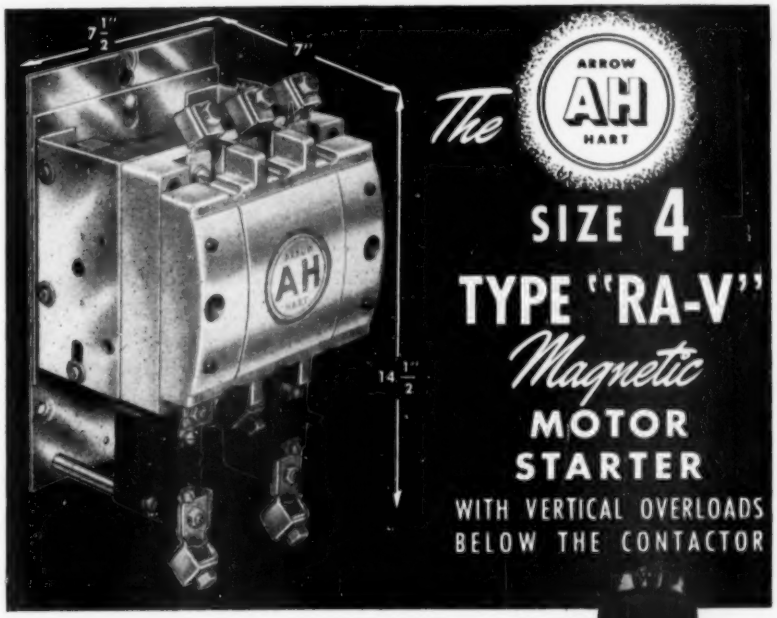
Annin Co. Appoints Earle Sales Manager

Henry C. Earle, Jr., has been appointed sales manager of The Annin Co., Los Angeles, manufacturers of control valves.

Earle comes to Annin with an extensive background of 20 years' experience in the instrument and control-valve business. For the past 6 years he has been Los Angeles district manager for a large manufacturer in this field.

Working out of Annin's Los Angeles office, Earle will devote himself to outside distributor contacts for Annin, mainly in sales and application engineering.

(Continued on page 410)



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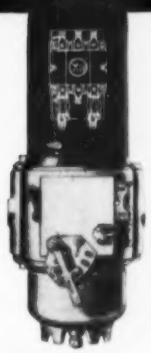

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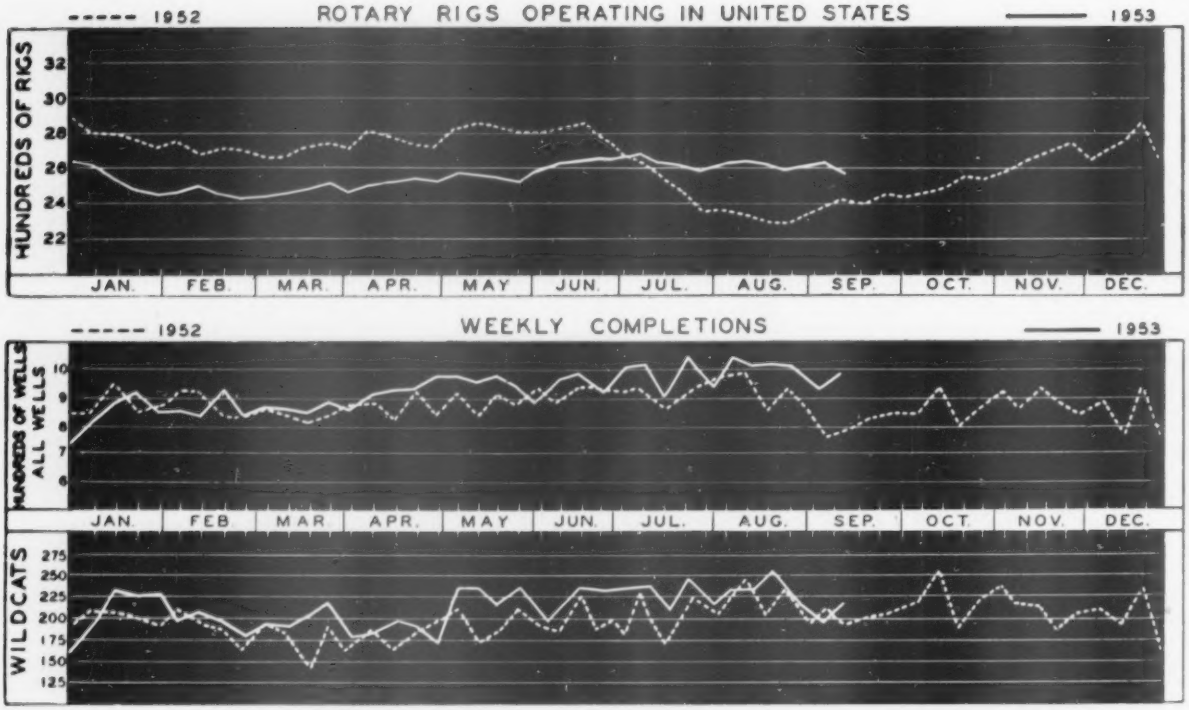


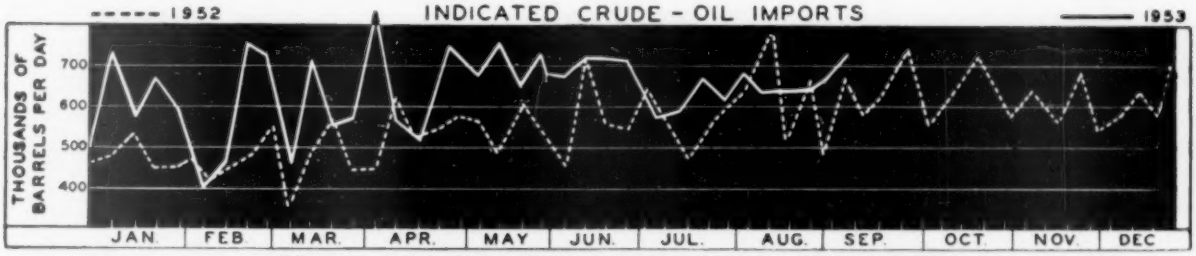
CURRENT STATISTICS

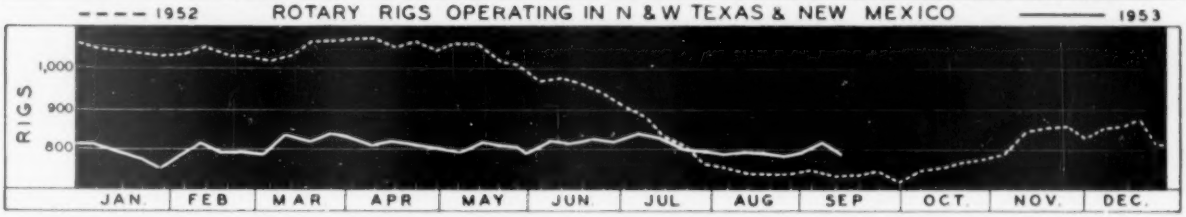
EXPLORATION

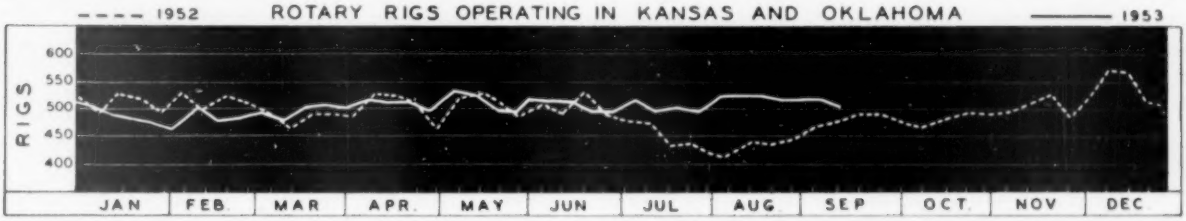
WEEKLY WELL COMPLETIONS . . . WEEK ENDED SEPTEMBER 12, 1953

	Total of all wells					Sept. 12		Wildcat completions and discoveries									
													Cumulative total, 1953				
	Comp.	Oil	Gas	Dry	Footage	1953	1952	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	18	9	0	*9	26,375	520	565	0	0	0	0	0	0	0	0	0	0
Pennsylvania	47	21	5	†21	86,200	1,294	1,384	0	0	0	0	0	0	0	3	11	14
West Virginia	7	1	4	2	20,770	436	417	0	0	0	0	0	0	0	8	4	12
Ohio	26	5	9	12	40,902	735	735	0	0	1	1	2	2	0	3	13	18
Indiana	21	7	0	14	32,243	908	868	0	0	0	8	8	11	0	2	244	257
Kentucky	29	11	4	14	61,587	776	901	0	0	0	3	3	7	0	1	127	135
Illinois	37	17	0	20	93,737	1,316	1,410	0	0	0	6	6	5	0	0	282	287
Michigan	13	4	0	9	22,155	417	494	1	0	0	6	7	12	0	5	171	188
Kansas	114	59	10	45	380,094	3,412	3,251	1	0	1	17	19	73	0	28	538	639
Nebraska	3	0	0	3	12,291	231	190	0	0	0	3	3	14	0	4	99	117
Oklahoma	162	91	7	164	513,298	5,114	4,048	2	0	1	10	13	82	6	26	445	559
Texas	324	172	23	129	1,578,935	12,001	12,541	17	0	2	84	103	621	41	134	2,953	3,749
North Central (Dist. 7-B & 9)	106	56	0	50	353,998	4,519	4,013	7	0	0	31	38	324	0	14	1,200	1,538
West (Dist. 7-C & 8)	88	61	0	27	519,575	2,599	3,882	6	0	0	17	23	125	2	12	471	610
Panhandle (Dist. 10)	14	7	6	1	42,579	556	491	0	0	0	0	0	0	2	0	15	17
Eastern (Dist. 5 & 6)	16	3	1	12	82,885	551	588	0	0	0	8	8	15	2	4	189	210
Gulf Coast (Dist. 2 & 3)	55	21	13	21	370,695	1,777	1,863	1	0	1	16	18	79	16	55	471	621
Southwest (Dist. 1 & 4)	45	24	3	18	209,203	1,999	1,704	3	0	1	12	16	78	19	49	607	753
Louisiana	35	21	3	11	236,051	1,802	1,604	1	0	0	6	7	56	25	17	245	343
Northern	16	9	3	4	64,929	736	859	0	0	0	2	2	7	2	2	90	101
Southern	19	12	0	7	171,122	1,066	745	1	0	0	4	5	49	23	15	155	242
Arkansas	17	10	0	7	60,277	356	270	1	0	0	4	5	11	0	0	79	90
Mississippi	8	1	0	7	55,953	256	253	0	0	0	5	5	12	1	4	122	139
Southeastern States	4	0	0	4	21,834	102	47	0	0	0	4	4	1	0	0	83	84
Montana	15	3	1	11	37,304	280	200	0	0	0	3	3	10	0	0	70	80
Wyoming	13	6	1	6	51,033	492	458	1	0	0	1	2	17	0	1	89	107
Colorado	11	6	0	5	57,599	472	298	1	0	0	3	4	21	0	9	208	238
Utah	3	1	0	2	17,476	50	53	0	0	0	2	2	2	0	4	28	34
New Mexico	29	12	15	2	161,094	953	736	0	0	2	1	3	14	0	10	87	111
California	57	38	0	19	233,811	1,786	1,696	0	0	0	17	17	45	0	8	401	454
North Dakota	3	2	0	1	21,672	178	55	0	0	0	1	1	7	0	0	39	46
Miscellaneous	0	0	0	0	0	54	84	0	0	0	0	0	1	0	3	34	38
Total United States	996	497	82	417	3,822,691	33,941	32,558	25	0	7	185	217	1,024	73	270	6,372	7,739
Total previous week	931	505	58	368	3,837,803			33	0	5	160	198	999	73	263	6,187	7,522
Total September 13, 1952	799	388	69	342	3,116,260			27	1	4	160	192	995	63	177	5,937	7,172

Service wells included: *9, †18, ‡1.



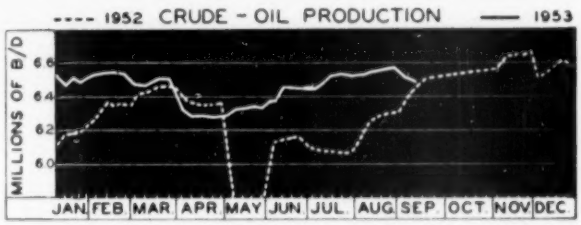


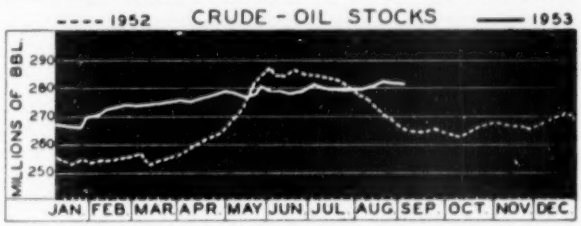


DAILY AVERAGE PRODUCTION FOR WEEK

	September 12			Sept. 5
	Crude oil	Lease condensate	Total	total
Alabama	5,300		5,300	5,100
Arkansas	77,850	400	78,250	77,850
California	1,003,600		1,003,600	1,009,800
Colorado	109,000		109,000	111,600
Eastern	59,200		59,200	59,200
Florida	1,525		1,525	1,525
Illinois	161,600		161,600	166,600
Indiana	34,700		34,700	34,200
Kansas	329,800		329,800	318,900
Kentucky	31,600		31,600	31,300
Louisiana	664,875	38,800	703,675	703,575
North	108,350	2,800	111,150	111,150
South	556,525	36,000	592,525	592,425
Michigan	32,600		32,600	31,800
Mississippi	92,800	3,500	96,300	96,900
Montana	32,600		32,600	31,200
Nebraska	16,300		16,300	16,400
New Mexico	200,850	550	201,400	200,750
Oklahoma	556,100		556,100	589,700
Texas	2,748,225	45,000	2,793,225	2,819,650
Dist. 1	39,575	350	39,925	39,950
Dist. 2	149,500	5,500	155,000	157,275
Dist. 3	444,500	22,800	467,300	470,050
Dist. 4	258,000	5,700	263,700	267,375
Dist. 5	48,250	400	48,650	49,075
Dist. 6	126,975	4,900	131,875	132,375
East Texas field	252,000		252,000	250,450
Dist. 7-B	116,675	50	116,725	117,850
Dist. 7-C	161,200	4,200	165,400	168,875
Dist. 8	888,025	700	888,725	901,950
Dist. 9	188,525	350	188,875	188,950
Dist. 10	75,000	50	75,050	75,475
Utah	5,100		5,100	5,000
Wyoming	215,300		215,300	209,000
North Dakota	14,200		14,200	14,100
Total U. S.	6,393,125	88,250	6,481,375	6,504,150
Change from previous week, down			22,775	
Canada	257,900		257,900	257,900
Total U. S. production January 1-September 12			1,646,296,125 bbl.	
Same period last year (crude plus cond.)			*1,571,964,775 bbl.	

*Includes 22,094,835 bbl. condensate.



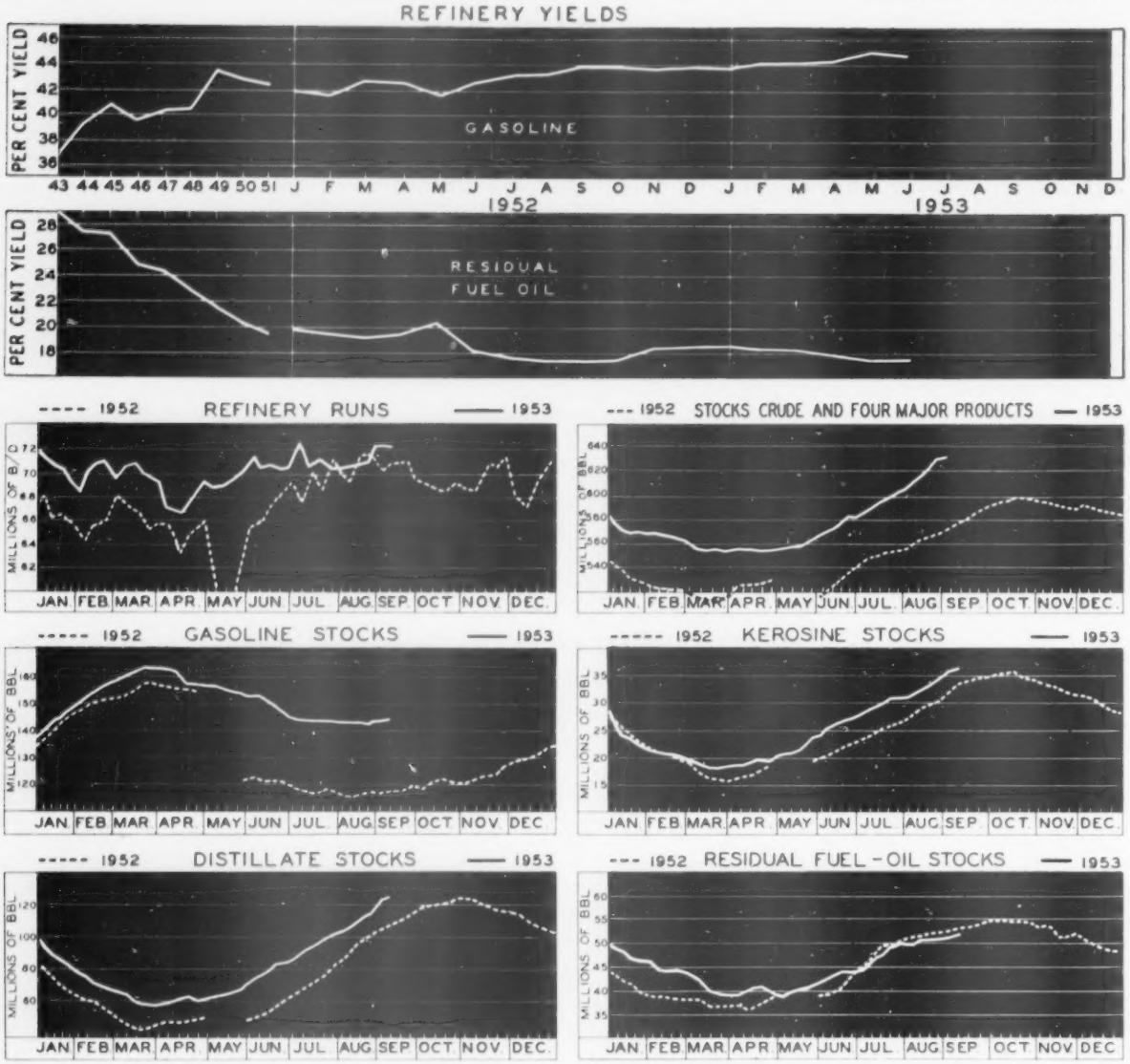


CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	Sept. 5, '53	Aug. 29, '53	Sept. 6, '52
Pennsylvania Grade	2,784	2,771	2,343
Other Appalachian	2,379	2,351	2,171
Illinois, Indiana, Michigan	12,236	12,262	12,999
Arkansas	2,851	2,872	3,185
Louisiana	17,248	16,806	15,816
North	2,809	2,771	2,476
Gulf	14,439	14,035	13,340
Mississippi	3,685	3,477	3,699
New Mexico	8,894	8,930	7,439
Oklahoma and Kansas	39,008	39,366	38,325
Texas	132,155	132,575	126,051
East Texas	11,028	11,505	13,326
West Texas	58,172	58,578	55,953
Texas Gulf	27,665	27,876	25,752
Other Texas	35,290	34,616	31,020
Rocky Mountain	16,390	17,045	14,772
California	32,851	33,884	31,420
Foreign	†10,746	10,372	7,445
Total	281,227	282,711	265,665

*Bureau of Mines. †Includes 3,027,000 bbl. in California.

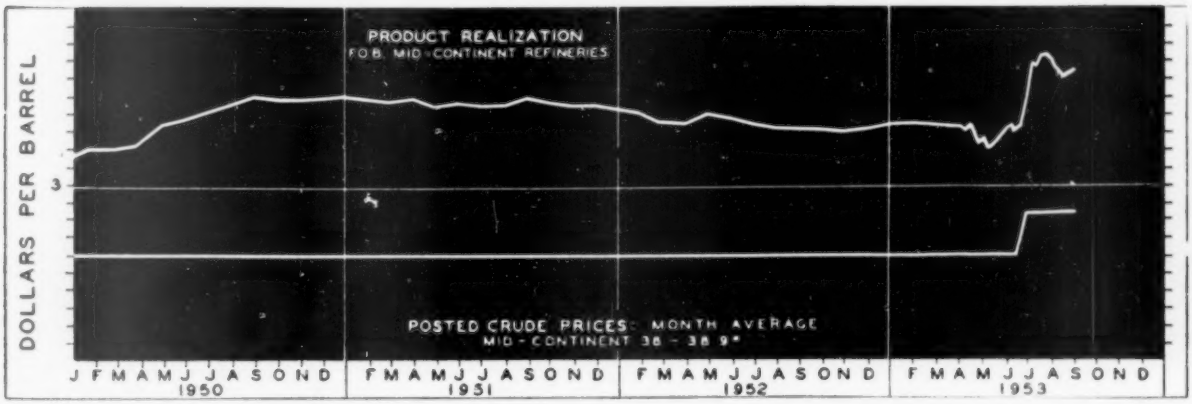

REFINERY YIELDS
PER CENT YIELD
GASOLINE
RESIDUAL FUEL OIL
43 44 45 46 47 48 49 50 51 J F M A M J J A S O N D J F M A M J J A S O N D
1952
1953
---- 1952 REFINERY RUNS —— 1953
MILLIONS OF B/D
--- 1952 STOCKS CRUDE AND FOUR MAJOR PRODUCTS — 1953
MILLIONS OF BBL
----- 1952 GASOLINE STOCKS —— 1953
----- 1952 KEROSINE STOCKS —— 1953
----- 1952 DISTILLATE STOCKS —— 1953
--- 1952 RESIDUAL FUEL-OIL STOCKS — 1953
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

A.P.I. REFINERY REPORT, SEPTEMBER 12

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks† Gaso.‡	Kero.	Dist.	Resid.	Bureau of Mines, September 1952 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,065	414.4	35.4	240.0	237.6	33,748	14,806	44,728	14,011	1,079	437.0	50.6	257.4	223.4
Appalachian:														
District 1	100	43.4	4.0	16.7	8.6	3,399	622	1,446	720	114	46.8	6.0	17.3	12.2
District 2	95	57.6	9.4	15.9	11.1	1,570	537	627	140	79	41.0	3.0	12.7	16.6
Ind., Ill., Ky.	1,316	749.0	62.6	227.4	173.9	29,114	9,291	22,488	4,784	1,283	704.2	71.3	238.2	158.7
Okla., Kans., Mo.	614	358.3	18.3	149.8	49.7	14,959	2,632	13,178	1,190	576	335.1	14.7	138.1	56.4
Inland Texas	266	181.4	9.9	50.7	35.3	5,622	636	2,071	1,561	256	183.1	11.7	45.0	37.9
Texas Gulf Coast	1,715	795.3	126.1	371.6	243.4	18,550	4,214	15,514	6,865	1,729	815.6	123.4	414.5	267.1
La. Gulf Coast	581	289.6	40.6	164.6	50.0	7,974	2,761	7,537	1,579	508	256.1	50.1	140.9	56.8
N. La. and Ark.	86	34.4	6.0	19.3	6.1	2,997	665	779	109	87	36.3	7.2	21.4	6.7
Rocky Mountain:														
New Mexico	18	11.7		2.4	3.6	183		41	27	16	10.4	0.6	2.5	3.4
Other Rocky Mtn.	266	130.0	4.1	58.4	45.7	4,644	260	2,791	1,009	246	117.8	5.9	46.9	44.2
California	1,094	486.0		146.6	394.4	20,727	375	14,464	19,765	1,044	444.9	5.4	166.9	346.2
Sept. 12, 1953	7,216	3,551.1	316.4	1,463.4	1,259.4	143,487	36,799	125,664	51,760	7,017	3,428.3	349.9	1,501.8	1,229.6
Sept. 5, 1953	7,228	3,543.6	327.9	1,439.3	1,306.9	142,850	35,901	120,974	51,030					
Sept. 13, 1952	7,059	3,447.4	358.9	1,484.0	1,217.6	117,296	33,724	108,641	53,274					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipe lines.


PRODUCT REALIZATION
F.O.B. MID-CONTINENT REFINERIES
DOLLARS PER BARREL
3
POSTED CRUDE PRICES - MONTH AVERAGE
MID-CONTINENT 38 - 38.9°
J F M A M J J A S O N D
1950
F M A M J J A S O N D
1951
F M A M J J A S O N D
1952
F M A M J J A S O N D
1953

In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate and fuel oil. Realization averaged $3.66 for week ended September 5, $3.64 for previous week, and $3.32 for September 1952. The above trend information is based on volumes and current prices and therefore does not reflect changes in operating costs.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of September 16, 1953. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline	11.125-11.625	13-13.8	11.25-11.75
Premium gasoline	12.25-12.875	14.5-14.8	12.5-12.75
42-44 w.w. kerosine	8.875-9.25	10.15-10.4	9-9.5
No. 2 straw fuel oil	7.875-8.25	9.15-9.4	8-8.5
No. 6 residual	$1.10-1.25	$2.15-2.40	$1.80-1.90

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	6.375	5.875	6.125
Grade 18-55	7.65	7.15	7.40

LUBRICATING OILS

South Texas

200 vis., No. 2-3 neutral	13.75
750 vis., No. 3-4 neutral	16.75
2,000 No. 5-6 neutral	18-18.75

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	20.5-21.5
200 vis, No. 3 neutral, 0-10 pp.	14.5

Western Pennsylvania

145-155 vis., 10 p.t. bright stock	25.5
180 vis., 10 p.t. neutral	27.5

WAX

Mid-Continent

132-134 A.M.P.	6.0

MARKET tone or feeling in the Mid-Continent at the middle of September was improved slightly from late August, but none of the suppliers contacted could give concrete evidence of actual improvement in sales or prices.

Group 3 gasoline in the line is still available at prices near 11.25 cents a gallon plus pipe-line transportation charges. Also, movement of home-heating oils is still confined to movement against contracts. No spot activity in distillates is reported, but there has been no abnormal movement of distress material. If a buyer were looking for distillate fuel, he probably could find it at pipe-line terminals at the Group 3 low plus pipe-line charges, but no suppliers are reported pushing No. 2 at this price.

Movement of home-heating fuels on the East Coast still lags behind normal. There is some talk of extending the date of expiration of summer discounts, now set for the end of September. The question now is whether the lack of sales is the cause or the effect in the current rumor of extending the discount period. The lack of movement may cause the closing date to be shifted to some time in October to make it possible for suppliers to take care of last-minute orders. On the other hand, the lack of sales may have been due to the soft market and the general feeling that the market would not sustain a return to normal prices by the end of September. Some buyers are still looking for a break in the light-fuel market.

Some increase in the number of price wars at service stations is reported, particularly on the East Coast and in the north central states. Sharp increases in these price wars are additional indicators of a soft market.

Medium-octane and low-octane gasolines are soft on the Gulf Coast market, but very little activity is reported for any grade gasoline except for normal shipments against contracts.

CRUDE PRICES GRAVITY SCHEDULE

	Signal Hill, Calif.*	Oklahoma, Kansas	Gulf Coast Tex.†	West Tex.‡
14-14.9	$1.87			
15-15.9	1.93			
16-16.9	1.99			
17-17.9	2.05			
18-18.9	2.11			
19-19.9	2.18			
20-20.9	2.24	$2.50		$2.37
21-21.9	2.30	2.52		2.39
22-22.9	2.37	2.54		2.41
23-23.9	2.45	2.56		2.43
24-24.9	2.53	2.58	$2.91	2.45
25-25.9	2.61	2.60	2.93	2.47
26-26.9	2.69	2.62	2.95	2.49
27-27.9	2.76	2.64	2.97	2.51
28-28.9	2.83	2.66	2.99	2.53
29-29.9	2.91	2.68	3.01	2.55
30-30.9	2.97	2.70	3.03	2.57
31-31.9	3.04	2.72	3.05	2.59
32-32.9	3.12	2.74	3.07	2.61
33-33.9		2.76	3.09	2.63
34-34.9		2.78	3.11	2.65
35-35.9		2.80	3.13	2.67
36-36.9		2.82	3.15	2.69
37-37.9		2.84	3.17	2.71
38-38.9		2.86	3.19	2.73
39-39.9		2.88	3.21	2.75
40 and above		2.90	3.23	2.77

*Standard Oil Co. of California. †Upper Texas Gulf Coast. ‡Includes New Mexico Permian.

Prices East of California effective June 15, 1953. California prices effective February 16, 1953. Pennsylvania Grade prices effective August 1, 1953.

FLAT CRUDE PRICES

Representative posted schedules per barrel.

Louisiana:	
Cotton Valley (distillate)	$3.00
Cotton Valley (Holloway crude)	2.95
Texas:	
East Texas	2.90
Chapel Hill	2.83
Conroe	3.13
Van	2.73
Pennsylvania Grade:	
Bradford	4.55
Southwest Pennsylvania	4.11
West Virginia	4.05
Ohio	4.04
Illinois Basin	3.02

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MODEL E563-42 Cooper well service unit, servicing to 6000 ft., skid mounted, 8x10x80' mast, excellent condition, $4,500.00. The Zeligson Company, Tulsa, Oklahoma. 8-4477. P.O. Box 5008.

SALES and rentals of cable drilling and fishing tools, casing and equipment, from the Southwest's largest stock of used cable tools and oil field supplies. Degen Pipe and Supply Co., Tulsa, Oklahoma

FOR SALE: U-15 rotary rig like new, including trailer house fully equipped. Wonderful buy. Available only because of health. Now drilling in West Texas. Inspect while in operation to get better idea. H. W. Sullivan, 611 Gulf States Bldg., Dallas 1, Tex.

FOR SALE: One 1280-gal. tank truck. New pump & meter. Good shape. R. J. Buehler, Box 121, Crown Point, Indiana.

JOY 300 Drilling Rig, butane powered, mounted on Brockaway 6x6 truck, 3500 feet 3½ inch drill pipe. Auxiliary mud pump and butane engine as separate unit. All tools and equipment included. This rig in first-class working condition and ready to go to work immediately. Call or write Steele Brothers, Crete, Nebraska. Phone 127.

FOR SALE: 1951 Cessna 195; 245 HP; 400 total hours; Cross-wind Gear; VHF; OMNI; Gyros; Hangared; Brand new condition; one owner; $10,000.00; write Box G-582, The Oil and Gas Journal, Tulsa, Oklahoma.

MUD-LOGGING TRAILERS

WE HAVE BEEN FORCED OUT OF BUSINESS BY HIGH TAXES AND GOVERNMENT RED TAPE
Dissolution of Company

SACRIFICE SALE FOR TAXES

Ten mud logging trailers completely equipped with gas detecting equipment, U. V. boxes, microscopes, mud analysis equipment, sleeping accommodations, excellent condition. To be sold in one lot.

TERMS $30,000 CASH

Also three two-way radio systems for sale covers 100 miles.
Ideal set-up for major company. These laboratory trailers can be advantageously used on all wildcat and development wells. Why let your well sitters sleep in cars when you can get a better job with this equipment? Also available ten experienced supervisory geologists who can operate this equipment and should make good hands for some company.

Box G-697
THE OIL AND GAS JOURNAL
Tulsa, Oklahoma

EQUIPMENT FOR SALE

FOR SALE: Eight 6" OD x 2¼" ID x 30' Reed Drill Collars equipped with super shrunk grip connectors—very low footage. W. D. Kelley Estate. Pampa, Texas. Phone 2236 or 1108.

FOR SALE: 1—M318-32—Cooper Double Drum Winch w/Cross Arm Spudder, including electric starting, air front controls, combination carburetor for gas, gasoline, & butane, and one 62 ft., 3 sheave heavy duty mast. Equipment mounted on 3 Ton International tandem truck. Williamson Well Service, Okmulgee, Okla. Phone 249.

Gaso Duplex 4½" x 6" Power Pumps with Chrysler C-36 Engines, skid mounted, immediate delivery. Also Byron Jackson, Carter Centrifugal Units. Westinghouse 20-25-50 KW Generating Units

H. H. COFFIELD
Attn.: W. H. ORR
Phones: 132—Rockdale, Texas
AT-3427—Houston, Texas

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New and Used material—Immediate delivery from stock, Angles, Channels, I and WF Beams, especially for construction needs.

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Phone or Wire your steel requirements.

We are also interested in purchasing your surplus material. We assure you our prices will be the best obtainable

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Astoria 8-4484 8-8023

EQUIPMENT FOR SALE

EVERYTHING in new and used equipment for well drilling. Fishing tools rented Save money, get quotations from Pressey & Son, Pueblo, Colorado.

FOR SALE: Type 80 Cooper gas compressors. Good condition. Alfred B. Kern, 223 Wright Building, Tulsa, Oklahoma.

REPRESSURING plant with Ingersoll-Rand compressor 4¼ X 10 and 10 X 10 Imperial type XOB10, 50 HP 2 cycle Superior engine, circulating pump, 2 200 bbl. cypress tanks, orifice flanges, scrubbers, building. Complete in every respect with lots of new spare parts. Write or call R. A. Putman, phone 2-6663, City National Bldg., Wichita Falls, Texas.

5395 FT. 4½" O.D. 16.60# National Tube Grade "D" Drill Pipe, with Hughes Flash-weld Hard-faced Joints. Mill shipment price. Immediate delivery at Midland, Tex., yard. Mid-Union Drilling Corporation, 624 South Cheyenne, telephone 4-8163, Tulsa, Oklahoma.

USED EXCELLENT CONDITION
IN OPERATION

One Each (4¾" to 1") (8⅝" to 2⅜") (13⅜" to 4½") LANDIS Leadscrew Receding Head Pipe Threading and Cutting Machine Motor Driven.

OILFIELD SALVAGE CO., INC.
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10,000' 16" O.D. 5/16" Wall
3,000' 16" O.D. ¼" Wall
Good used in excellent condition

A. A. GILBERT PIPE & SUPPLY CO
Shreveport, La.
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60,000' 3½" OD weight 6.50 TC electric weld and seamless, new.
45,000' 4½" OD weight 9.50 T & C electric weld and seamless, new.
10,000' 2⅜" OD J-55 weight 4.70 upset tubing, new.
40,000' 6⅝" OD weight 18.97 seamless Range 2 used 4 years product line, beveled for welding guaranteed A-1.

All above priced to sell. Cash or terms.

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GOOD 5500' ROTARY RIG
REASONABLY PRICED

126' Lee C. Moore Mast with 5'6" high Substructure.
G-36 Emsco Drawworks with two JL-1335 Buda Engines.
FXZ Gardner-Denver 7¼" x 12" Pump.
150-Ton Swivel and Traveling Equipment.
MS-15 Emsco Rotary independently powered through GM Torqmatic transmission.
10¾" Shaffer Blowout Preventer.
Two water pumps, water well jack 7" and 10¾" casing tools, Overshot, two tool houses, good water tanks, ample line pipe, shale shaker and complete accessories.
Located in Beckham County, Oklahoma

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TULSA, OKLAHOMA
PHONE LD-204 OR 4-1144

WILSON GIANT RIG, 500 Transmission, 2 L.I. 600 Cummins Diesel Engines Compounded, 7¼ X 14 Pump, 95′ Hispeed Lee C. Moore Mast, Drill Pipe nearly new. Complete ready to run. Price $57,500.00. Box G-700, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: Late Model 83 Speedstar with rubber shock mast. Star Drilling Supply Co., Box 151, Chanute, Kans., Phone 467.

FOR SALE: At Madison, Kansas, 40 tons of ¾" and ⅞" used pull rods with clamps. Suitable for reuse or construction purposes. These rods are clean and reasonably straight. Price $80.00 per net ton. Also 20,000′ ¾" sucker rods recently reclaimed from waterflood operations. Suitable for reuse. 15c per foot. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

FOR SALE

SUPERIOR HEAVY DUTY DIESEL

510 hp. at 360 r.p.m.—5 cylinder—14½x18 type ZDSB — non-reversing — vertical—4 cycle—cold starting—mechanical injection. Engine is totally enclosed. Complete with a 48" 7 groove V-belt sheave and new spare parts. For heavy duty pumping, dredge service, power generation, textile and saw mills, mining, etc. EXCELLENT CONDITION, IMMEDIATE DELIVERY.

G. M. 3-71 DIESEL GEN. SET

30 kw. 2 cylinder 4½x5 diesel—radiator cooled—electric starting. Delco 3-60-440 generator — with switchgear. Skid mounted. Portable.

30 KW SHEPPARD DIESEL SETS

30 kw. Sheppard—115 volts DC—radiator cooled. Built 1950. Excellent condition. Self-mounted radiator and fuel tank. 16 units available.

60 KW CUMMINS DIESEL GEN. SET

120/240 volts D.C.—3 wire. Engine: 6 cyl. model H—heat exchanger cooled.

60 KW G.M. 6-71 DIESEL GEN. SET

Engine: G.M. 6-71 4½x5—6 cyl.—heat exchanger cooled. Generator: Star Electric—120 volts D.C.—500 amps.

75 KW WAUKESHA DIESEL GEN. SET

Totally enclosed. Engine: Waukesha diesel 6¼x6½—160 H.P. @ 1200 R.P.M. Generator: G. E. 75 kw. 230 volts D.C.—231 amps.—full load 300 volts.

100 KW G. M. 3-268A A.C. DIESEL GENERATOR SETS

440 volts—3 phase—60 cycle. 20 kw. D.C. generator on same shaft—5 kw. exciter—120 volts D.C.—electric starting.

300 KW G. M. D.C. DIESEL SET

ENGINE: G.M. 8-268A—6½x7—1200 r.p.m.—air starting. GENERATOR: 300 kw G.E.—120/240 volts D.C.—3 wire—totally enclosed—Marine type BB—with switchgear.

STEAM TURBO-GENERATOR SETS

300 kw—120/240 volts D.C.—1200 r.p.m.—1250 amps.—turbine W.P., 225 lbs. to 440 lbs.

ENGINES SUITABLE FOR CONVERSION TO NATURAL GAS

(5) New STERLING marine gasoline engines. 900 H.P. @ 2100 RPM; 1200 H.P. @ 2800 RPM. 6⅜x6½—electric starting.

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WINCHES SUITABLE FOR DRILLING RIGS

Hunt Tool Co.—double drum double gypsy. 50 H.P. 230 volt D.C. motor and hand brake. Complete with controls. Condition equal to new. 20 units available.

LARGE DRILLING RIG MOTORS

(4) 1375 H.P. @ 1300 RPM—415 volts D.C. Can be used as 700 RPM 230 volt D.C. motors @ 600 RPM. G. E.—Ex. Cond.

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OUTSTANDING FEATURES

★ 2500 BBL. Crude Unit
★ 1770 BBL. Thermal Cracking Unit
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★ **100 BBL. POLYMERIZATION UNIT**
(Installed new 1951, skid-mounted)

Recycling Plant, Complete

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TOTAL CAPACITY—50 MILLION CUBIC FEET PER DAY

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Refinery & Gasoline Plant Equipment, Inc.

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FOR SALE: 8500′ good used ⅞" sucker rods for 20 cents per ft. Call or write James A. Shepard, Hoisington, Kansas. Phone 546.

FOR SALE: C-150 National Pump—First-Class Condition. Meridian Drilling Co., Inc., 1514 Liberty Bank Building, Oklahoma City, Okla. Telephone CE 2-2055.

7—8000 GAL. R.R. TANK CAR tanks with heating coils in New Jersey $685 each. Lestan Corp., Rosemont, Pa.

VACUUM PUMP: Unused 1946 Model—Ingersoll-Rand Model V-67 Single Stage—Size 6 X 6 X 5 with 2" Suction and Discharge, equipped with 5 HP General Electric 440 Volt Motor 3 phase 60 cycle, 1750 R.P.M. F.O.B. Price, St. Elmo, $500.00. SCHROEDER & HERMANN, 898 Haller Ave., Wood River, Illinois.

FOR SALE: 10,000′—4½" drill pipe, with tool joints cut off, located at Hobbs, New Mexico. Makin Drilling Company, Box 1628, Hobbs, New Mexico.

IN EAST TEXAS: Pipe, scrap iron and metal business fully equipped. Landis pipe machines. Fairbanks-Morse Scales, buildings, lots. Very reasonably priced. Mrs. H. Stein, Box 1085, Overton, Texas, phone 5781.

FOR SALE, MATCHED PAIR OF HALL SCOTT INVADER

Engines, right and left rotation 275 H.P. each. Manufactured and delivered 1951. Used not exceeding 150 hours. Radio shielded. In perfect condition.

Box G-588, The Oil and Gas Journal, Tulsa, Oklahoma

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ARMITE LABS., 6069 Broad St., Los Angeles 1, Calif.
The Wm. H. Mason Co., 212 N. Denver Ave., Tulsa, Okla.

A SURE SOURCE OF SUPPLY AT ALL MARKET LEVELS FOR CASING, TUBING AND LINE PIPE. INQUIRIES SOLICITED.

FOR SALE at Roundup, Montana, a quantity of 7⅝" 26.4#, new, 8⅝" 32# new and used, and 36# new casing. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

TWO Mayhew 1000 drills mounted on International trucks, 2 years old, excellent condition. Box 275, Phone 340, Andrews, Texas.

USED MATERIAL FOR SALE: 7000′—7" OD 24# 10Vthd Seamless R-2 Grade C Casing. 57000′—7" OD 24# 10Vthd L.W. R-1 Casing. 75000′—2" EUE 4.70# R-2 10Vthd Seamless Tubing. 6,000′—4½" OD EUE J-55 8RD R-1 Seamless—good for Casing. 75000′—⅝ and ¾" Sucker Rods. 15—20HP T. C. on skids 54" stroke Pumping Units. Sabine Pipe & Supply Co., Phones 3094—3095, Kilgore, Texas.

SULLIVAN 200, trailer mounted, complete with all tools, contact for inventory and price. Mesker Drilling Company, Box 6157, Tulsa, Phone 5-9357.

90 H.P. 2 CYCLE Superior Direct Driven Compressor Unit with 5½" high and 11" low pressure Cylinders, with Novo Air starting unit and steel house. Suitable for pulling vacuum and recycling gas. Near Pawhuska, Okla. Earl Davis, P.O. Box 7005, Tulsa 18, Okla.

OIL FIELD EQUIPMENT

Greenwood County, Kansas—Near Quincy, Kansas, 4 wells—1380′ in depth, 4½" casing, 2" tubing, ⅝" rods, misc'll fittings, lead line, Jensen & National Pumping Units with electric motors & time clocks, 2—100 bbl. tanks, 1—Redwood Gun Barrel. Equipment less than 3 years old. New cost of equipment over $16,000.00. Sale price $8500.00. Woodson County, Kansas—Near Gridley, Kansas, 12 wells—1650′ in depth, 4½" casing, 2" tubing, ⅝" rods, misc'll fittings, lead line, Jensen & Bethlehem pumping units with electric time clocks. Equipment less than 4 years old. New cost of equipment over $45,000.00. Sale price $25,000.00. Woodson County, Kansas—Near Yates Center, 2 wells—1600′ in depth, 4½" casing, 2" tubing ⅝" rods, misc'll fittings, lead line, 1—Jensen Pumping Unit, 2—100 bbl. tanks (old), 1 Redwood Gun Barrel (old), 1 well pulled—Equipment on ground. Equipment in wells less than 1 year old. New cost of equipment over $9500.00. Sale price $4500.00. Marion County, Kansas—Near Hillsboro, Kansas, 1 well—2800′ in depth, 5½" casing, 2" upset seamless tubing, ⅝" rods, misc'll fittings. 1—100 bbl. tank. Equipment less than year old except ⅝" rods. New cost of equipment over $8000.00. Sale price $4150.00. New cost of equipment on all leases was in excess of $78,500.00. If equipment is sold to one purchaser the price is $40,000.00; however, equipment may be sold by well or by lease. For further information contact—Geo. B. Emery, Jr., Box 498, Topeka, Kansas, Telephone 3-6770, Topeka.

WANT EQUIPMENT: Did you find the equipment you wish to purchase in this column? If not, use an "Equipment Wanted" classified advertisement to find it. It is available somewhere and Journal classified advertisements will find it. See box heading for classified rates, or write The Oil and Gas Journal.

EQUIPMENT FOR SALE

FOR SALE at Okla. City whse., 1 used 8" x 3¼" x 8" Ingersoll-Rand type 20 high pressure, 2 stage portable compressor. Serial #PP71898 driven by model GU2S 5⅜" x 6¼" Waukesha engine Serial #76426 mounted on steel wheels. Price $1500.00. Cities Service Oil Co., Patridge, Bartlesville, Oklahoma.

EQUIPMENT WANTED

WILL PAY highest prices for used casing, used line pipe, abandoned leases, or other surplus lease equipment. Your idle producing equipment is worth dollars. Green Pipe & Supply Co., Box 1383, Tulsa, Oklahoma.

NOTICE: We buy. We sell equipment everywhere. If you want to sell or buy contact Pressey & Son, Pueblo, Colorado.

WANTED: Bucyrus 36-L or 48-L spudder, immediately. Advise details Airmail. Keith Morton, Valier, Mont.

EQUIPMENT NOT IN USE: Did you find a buyer in this column for the equipment you have for sale. Someone wants it and an "Equipment For Sale" classified advertisement in the Journal will find a buyer. See box heading for classified rates or write The Oil and Gas Journal.

HELP WANTED

CHEMIST to take charge of large independent oil company laboratory located in Great Lakes area. All applications strictly confidential. Experience required in laboratory administration. Give full details of education and experience. Reply to Box G-687, The Oil and Gas Journal, Tulsa, Oklahoma.

MANUFACTURERS AGENT, Commission Sales Representative, or Sales & Service Firm to handle outstanding lines of oilfield specialty products for Manufacturer-Distributor. Must have close personal contacts with steam and power drilling rigs and operating personnel in area. Several territories available: portions of Louisiana and Texas Gulf Coast, Rio Grande Valley, East Texas, possibly others. Box 6352, Houston 6, Texas.

EQUIPMENT INSPECTION ENGINEERS

South America

A major oil company affiliated with Standard Oil Company (N. J.) needs graduate engineers with several years' refinery process equipment inspection experience. Must be qualified to interpret codes and specifications, predict equipment renewals, and recommend replacement equipment.

Write giving age, martial status, education, and full details of experience.

Box 308-K
Radio City Station
New York 19, N. Y.

HELP WANTED

VACANCIES for experienced Geologists in Indonesia and India/Pakistan. Write Oil Industry Employment Service, 405 Tuloma Bldg., Tulsa, Okla. 4-5974.

OIL Industry Employment Service, 405 Tuloma Bldg., Tulsa, Okla. 4-5974. Tom Robinson, owner. For Technical and Trained Personnel, including LPG.

MAJOR DRILLING COMPANY has position in the U. S. for combination electrician-mechanic capable of working on electrical drilling rigs. Write Box G-673, The Oil and Gas Journal, Tulsa, Oklahoma, giving full particulars if interested.

PETROLEUM ENGINEERS

FOREIGN SERVICE

Graduate engineers with good background in general physics, mathematics, mechanics and with some laboratory experience in equipment and techniques. For laboratory position responsible for theoretical experimental studies on reservoir fluid and rocks. Duties will consist of designing equipment, performing or supervising, testing and analyzing and reporting results. Studies pertinent to evaluation of primary depletion practices and applicability of secondary recovery for pressure maintenance operation will be required.

Please write giving full particulars regarding personal history and work experience. Please include telephone number.

RECRUITING SUPERVISOR
BOX OG-5
Arabian - American Oil Company
505 Park Avenue
New York 22, N. Y.

Geophysical Personnel

Newly organized subsidiary of Standard Oil Company of California needs Party Chiefs, Computers, and trainees with educational background in geological and geophysical sciences.

Please write giving full particulars regarding personal, educational and experience qualifications or call for appointment interview.

CHEVRON OIL COMPANY
3800 West Alabama
Houston 6, Texas

Rig manufacturer wishes to employ graduate engineer with 5 to 10 years oil field experience for sales promotion, advertising and production planning. Permanent and lucrative position to man who can produce. Reference and experience with first letter requested. Box G664, Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co. Box 2603, Tulsa, Okla. $5.00 cash.

ENGINEERS, Executives, Technical Men. Salaried positions—$3600 to $30,000. This confidential service for outstanding men who desire a change of connection. Will develop and conduct preliminary negotiations without risk to present position. Send name and address for details. Tomsett Associates, 434 Frick Bldg., Pittsburgh 19, Pa.

THE POSITION YOU WANT: Oil industry companies are looking for men to fill every conceivable kind of position. If you didn't find the position in this column that you are looking for, use a "Situation Wanted" classified advertisement to state your qualifications. Some company is probably looking for your ability. See box heading for classified rates or write The Oil and Gas Journal.

EXECUTIVE SALES ENGINEERS (3)
New York & Chicago Territories
Also one for National Travel

Will contact top executives personnel in petroleum & chemical industries, for refinery & chemical plant construction sales.

General knowledge of refining and chemical processes plus sales ability essential.

Rapidly expanding established organization operating nationally.

Send complete resume to
General Sales Manager

Box G-686, The Oil and Gas Journal, Tulsa, Oklahoma

SITUATIONS WANTED

CHEMICAL AND GAS ENGINEER: 33 years old, single, M.S. in chemical and gas technology. (Institute of Gas Technology) Five years experience in chemical, four in natural gas industry. Chemical research. Supervisory experience. All phases of natural gas design, FPC reports and testimony. Economic studies. Know accounting. Technical articles published. Box G-684, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST. University of Wisconsin 1950, married, age 31. Desires position with future. Box G-692, The Oil and Gas Journal, Tulsa, Oklahoma.

MANUFACTURERS AGENT, established Gulf Coast area, headquarters Houston, wants additional lines of mechanical and electrical equipment or specialties, calling on contractors, engineers, and process plants, Oil and Chemical industry. Box G-699, The Oil and Gas Journal, Tulsa, Oklahoma.

DUTCH GEOLOGIST, M.S. degree, desires position in States. Six years experience subsurface and field work, mainly Indonesia wth Standard-Vacuum. Seven months experience in States. 2107 Dublin Road, Oklahoma City. TRinity 8-3666.

LEASE RECORD or Landman. Supervisor, 13 years' experience, major company with 15 years' previous abstracting experience. Age 49, family, good references. Will relocate. Box G-695, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL COMPANY ACCOUNTANT, Secretary, Office Mgr.—Full Charge—Age 41, 21½ yrs. Corporation, Partnership, Individual and Estate experience. Miss Opal Wolf, WI-5194. 3324 Parkridge, Fort Worth, Texas.

CANADA: Geologist, 33, Family, German Immigrant, arriving October. Three years' experience, mainly subsurface. State nature of position, location. Box G-696, The Oil and Gas Journal, Tulsa, Oklahoma.

HAVE five years management experience in fair size oil operation, including exploration, development, production, sale of oil, leases, contracts, etc. Have master's degree petroleum engineering and substantial geological experience. Desire position with small group or independent interested in oil exploration and production. Presently located Rocky Mountain area. Box G-683, The Oil and Gas Journal, P.O. Box 1260, Tulsa, Oklahoma.

SITUATIONS WANTED

CONTROLLER, Office Manager, General Manager desires responsible supervisory or adminstrative position with oil or gas company. Nineteen years' diversified experience with independent producing and drilling companies. Accounting and tax background. References. Mid forties, married, will relocate. Box G-678, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER: B.S. Degree, 10 years' experience in production, drilling, and reservoir engineering. 8 years with major oil company, 2 years with small independent. Age 33. Desires position with either major or independent oil company anywhere in U.S.A. or Canada. Above average academic and professional background. Complete resume upon request. Box G-680, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION: Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No 1628, Ph. No. 3-3141, Hobbs, New Mexico.

LANDMAN—Legal training and 7 years experience major company office and field. Desires change to expanding independent. Can relocate and travel. Box G-675, The Oil and Gas Journal, Tulsa, Oklahoma.

CONST. SUPT. & ENGR. Completing refinery construction contract Middle East. Desires contacts leading to foreign contract. 15 years' heavy construction. Some Spanish. Box G-694, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER with 6 years' experience in fatty acid work wishes to become affiliated with Oil Company preferably in Northwest U. S. Howard Brandeland, 1065 South Fourth, Kankakee, Illinois.

GRADUATE mining engineer, mature, 38 years of age, with thirteen years' administrative experience as Naval Officer on active duty, and 6250 hours air transport pilot experience desires position utilizing background and experience. Box G-698, The Oil and Gas Journal, Tulsa, Oklahoma.

THE RIGHT MAN: Can you fill the position you have open from the qualifications listed in this column. Men are always looking for an opportunity to improve themselves. Use a "Help Wanted" Journal classified advertisement to find the men you need. See box heading for classified rates or write The Oil and Gas Journal.

EXECUTIVE Accountant—Office Management, taxes, insurance. Thoroughly experienced, under 40. Salary requirements $8,000.00. Confidential. Box G-674, The Oil and Gas Journal, Tulsa, Oklahoma.

FINANCING

AN AGGRESSIVE, successful, Mid-Continent oil producer desires financing adequate to support additional exploration activities. This is a chance to do business with one of the most aggressive new companies in the field. Box G-689, The Oil and Gas Journal, Tulsa, Oklahoma.

BOOKS FOR SALE

DOODLEBUGGING — DOWSING — DIVINING—A scientific and unprejudiced analysis of the influence of electromagnetic fields on psychic phenomena, with particular attention to divining (doodlebugging). PSYCHICAL PHYSICS by S. W. Tromp, Professor of Geology, Fouad I University, Cairo (Egypt), is a 534 page volume (153 illust.) in which the author analyzes all existing knowledge of divining phenomena. Oil operators will find this book thought provoking. Only 400 copies left. Write now for yours. Price $8.00. ELSEVIER PRESS, 402 Lovett Boulevard, Houston 6, Texas.

ELECTRICAL CONTRACTORS

Office Phone 5-5315 — Res. Phone 7-4950

W. L. RATCLIFF COMPANY

ELECTRICAL CONTRACTORS

Industrial—Commercial—Distribution

W. L. Ratcliff — 508 Caddo St

P. O. Box 373 — Shreveport, La.

ROYALTIES

WORLD'S LARGEST REGION for oil and gas condensate reserves and expectant oil fields, inquire for opportunities therein. A. S. Berry, P. O. Box 1383, Tulsa, Oklahoma.

GET TOGETHER: Both Capital and Royalties are available. If the investment proposition you want isn't listed in this column, use a Journal classified advertisement to find it. See box heading for classified rates, or write The Oil and Gas Journal.

LEASE AND DRILLING BLOCKS

SHALLOW DRILLING BLOCK: Interest checkerboarded on 9,300 acres in McCulloch County, Tex., to test the Cambrian Series through the Wilberns & Hickory. No Bonus, Override or Oil Payments. Quick action. J. E. Alexander, 1922-7st. Lubbock, Tex. pho. 34317; if no ans. call Brady, Tex. Brady Hotel pho. 2470; Lohn, Texas phone 19.

FOR SALE—MONTANA MINERAL RIGHTS—Cheap price range. Good return from lease rentals. Also CHEAP LEASES. All in active areas. N. R. Brasted, 816 Sinclair Bldg., FOrtune 3313, Fort Worth, Tex.

WANTED: Settled production approx. 1,000 bbl. daily, with additional acreage on which wells can be drilled. Stauffer, 108½ E. Grand River, Howell, Michigan.

FOR SALE: 160 acres, 12-year-old lease. Settled production 200 bbl., approximately $250,000.00 physical inventory. A dozen different pays—great possibilities. Must be a bonafide company. Major company preferred. Box G-681, The Oil and Gas Journal, Tulsa, Oklahoma.

WILL pay cash instantly for leases (large blocks), royalties, mineral deeds, production. Write fully—P. O. Box 2153, Denver, Colorado.

160-ACRE LEASE available central Okla. for drilling, no way condemned, flowing well adjoining farm, 3 oil sands in area. Approx. 6600, 7200 and 7600 feet. Some wells reported more than 1000 barrels. If you are regularly engaged in the oil business and interested, write Land Owner, Box 572, Chickasha, Okla.

TWO LOTS north outskirts Snyder; two north outskirts Okla. City; one each Stanton, Lott, Quanah, Texas. Want drilling. W. A. Epps, Pioneer Hotel, Tucson, Arizona.

WANTED: Shallow lease to drill, not over 1700 ft., in Oklahoma or southeast Kans. F. D. Asbury, 161-W-4th St., Hoisington, Kans.

DRILLING DEAL: 90 acres, Chanute, Kansas, area. Sandfrack. Must drill immediately. Box 35, Iola, Kansas.

LEASE. 5000 acres North Kansas Basin Marshall Co. near Platte pipeline. Pleistocene 45 feet, Simpson 990. Seepage. $1.50 acre, override. H. T. Harper, Vermillion, Kansas.

SEE A. L. Bowles, Rollow Building, Ada, Oklahoma, for drilling deals.

LOOKING FOR A LEASE? There will be over 40,000 wells drilled this year. If you are looking for a lease, drilling block, or drilling deal and haven't found it in this column, or if you have a lease or drilling block you want drilled, a Journal classified advertisement can find an interested party. See box heading for classified rates, or write The Oil and Gas Journal.

SW ROOSEVELT COUNTY, N. M.

McCabe No. 2 (7) NE NW¼ sec. 31, 2S, 31E, NE offset to No. 4 ready to drill making production tests in 2 oil sands above 3200 ft. Data this important Permian area on request.

W. J. PETERMAN, GEOLOGIST

Portales — 1919-1953 — New Mexico

LEASES ROYALTIES

Producing and Nonproducing

Bought and Sold—Any Area

Inquiries Invited

B. D. BUCKLEY

6635 Delmar Ave., St. Louis 5, Mo.

EUSINESS OPPORTUNITIES

INVENTOR of processes for tetraethyl lead gasoline antiknock material with issued patents, seeks party for financing and organizing business to refiners. G. F. Ruddies, 5646 Sheridan Road, Chicago, Ill.

RANCHES

GUEST RANCH in Wyoming's Jackson Hole country. Accommodates 20 guests. 160 acres with trout stream. Established 30 years. KASHFINDER, Wichita, Kans.

MAILING LISTS

MAILING LISTS of the oil industry. Our 30th year. Send for catalogue. Oil Industry Mailing List Co., 405 Tuloma Bldg., Tulsa, Okla.

REAL ESTATE

SPACE IS NEEDED: A Journal display classified advertisement is the quickest way to rent or sell your real estate. In the present period of expansion oil industry firms urgently need the space you have available. If it isn't listed here, you may also find it by stating your needs in these pages. For classified rates see box heading or write The Oil and Gas Journal.

AERIAL PHOTOGRAPHY

GOVERNMENT AERIAL PHOTOGRAPHY

Our integrated services of personal search reporting, prepaid orders, and delivery follow-up often save you a month's costly delay in difficult, unsatisfactory correspondence with numerous gov't agencies on procurement of inexpensive stereo prints, mosaics, etc. U.S. air coverage divided among various agencies each operating separately. Fees quoted on your job based on work required. Original gov't. prepayment receipts furnished, prints shipped direct. Searches for ready-made foreign air photography also made. **Write Dept. OG1.**

WASHINGTON COMMERCIAL CO.

1200 15th St. N.W., Washington 5, D.C.

LEGAL

Sealed bids will be received at the office of the Area Director, Bureau of Indian Affairs, Room 305, Federal Building, Albuquerque, New Mexico, until 2:00 o'clock, P.M. (MST), October 15, 1953, and then publicly opened for sale of oil and gas leases on 26 tracts of Jicarilla Tribal Indian lands totaling 65,745 acres, more or less, located in the Rio Arriba and Sandoval Counties of New Mexico on the Jicarilla Indian Reservation. Each tract containing four sections each, is offered for lease separately. For complete description of the land, location, provisions and stipulations of the leases to be sold, address the Superintendent Jicarilla Indian Agency, Dulce, New Mexico.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington 25, D.C. Notice is hereby given that approximately 40 acres of land comprising NW¼NW¼ sec. 24, T. 37 N., R. 4 E., within the known geologic structure of the Whitlash field, Liberty County, Montana, will be offered in one parcel for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre at 1 p.m., E.S.T., October 21, 1953, when bids will be opened. Details of the lease offering and how and where to submit bids may be obtained upon request from the Manager of the Land Office, Billings, Montana, or from the Bureau's Washington Office. L. E. Hoffman, Chief, Division of Minerals.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that approximately 1240 acres of public domain land, in three separate parcels, within the known geologic structure of North Shugart field, New Mexico, will be offered for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre at 1 p.m., E.S.T., October 28, 1953, when bids will be opened. Details of the lease offering and how and where to submit bids may be obtained upon request from the Manager of the Land and Survey Office, Santa Fe, New Mexico, or from the Bureau's Washington office. L. E. Hoffman, Chief, Division of Minerals.

EQUIPMENT MEN

(Continued from page 401)

Linde to Manufacture, Sell Pacific Pumps in Canada

Elmer J. Weis, vice president and sales manager of Pacific Pumps, Inc., (Huntington Park, Calif.) recently announced the signing of an agreement with Hugh Harper, president of The Linde Pump & Engineering Co., Ltd. (Montreal, Que., Canada), for the manufacture, sales, and servicing of Pacific custom-built centrifugal pumps in Canada. The pumps will be marketed under the trade name of Linde-Pacific.

According to Hugh Harper, president, the company will operate Linde-Pacific sales and service offices in Toronto, Winnipeg, Vancouver, as well as from the home office, Montreal.

The Linde Canadian Refrigeration Co., Ltd., with main offices at the same Montreal address is another Linde affiliate.

Personnel Changes Named By Franklin Supply Co.

Franklin Supply Co., Chicago, recently announced personnel changes which have occurred since June of this year.

William Kerin, Jr., formerly district sales manager at Mt. Pleasant, Mich., has been transferred to Oklahoma City in the same capacity. Charles Armstrong, salesman at Casper, Wyo., has been transferred to Mt. Pleasant, as district sales manager. Frank A. Northway has been transferred from his sales duties in Tulsa to Dallas.

Lee Croger, formerly store manager at Grayville, Ill., assumes the managership of the East Chicago, Ind., store. Wendell Kalck has been promoted from the tubular department of the general office to sales at Grayville. Frank Dorney, recently released by PAD in Washington, assumes the job of salesman at Tulsa, and Don Davis has been transferred from sales duties in Grayville, to Casper, Wyo.

Jene Harper, president, has also announced the opening of a new warehouse in Edmonton, Alta., Canada, by Franklin Pipe & Supply, Ltd., a subsidiary company. The warehouse is under the supervision of C. E. Sublett, vice president.

Ensign Carburetor Adds Cave to Engineering Staff

A. N. Cave has joined the sales-engineering staff of the Ensign Carburetor Co., at its Chicago headquarters. Cave, a graduate of Purdue University, comes to Ensign with engineering training as well as considerable practical field experience with internal-combustion engines. His work with Ensign will gradually develop into a position of sales and service, covering the eastern and midwestern states.

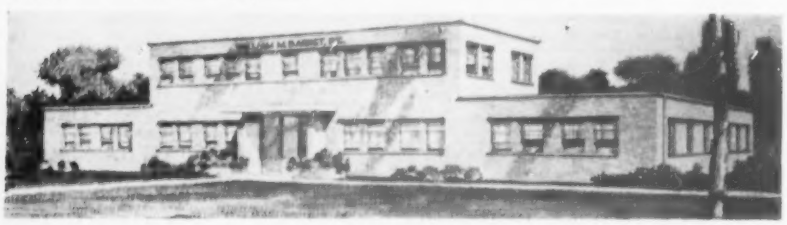
Tube Turns Establishes Branch Plant in Houston

Tube Turns, Inc., Louisville, has established a branch plant in Houston, to provide special service to the Southwest's petroleum industry. It makes possible immediate delivery of flanges bored and faced to the individual specifications of piping designers, as well as regular A.S.A. flanges.

All operations at the Houston plant are in charge of W. B. Whenthoff, Tube Turns' district manager.

Barret, Inc., Begins New Geophysical Plant

William M. Barret, Inc., consulting geophysicists of Shreveport, has announced the beginning of construction on a new geophysical plant in Shreveport. Scheduled for completion before the end of the year, the new plant will include the building illustrated here, which will house the administrative offices, laboratories, and instrument shops. Automotive shops will be located in another building, and a third structure will house the paint shop and a covered parking area. According to William M. Barret, president, the project, including buildings, real estate and equipment, will represent a total investment of approximately $250,000, and will furnish modern facilities to care for the growing demand for the company's geophysical services and equipment.



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Notice is hereby given that sealed bids on oil and gas leases on approximately 46,826.55 acres of Turtle Mountain Public Domain Allotments located in Daniels, McCone, Richland, Roosevelt, and Sheridan Counties in Montana, and Divide and Williams Counties in North Dakota, will be opened at 2:00 o'clock P. M., Mountain Standard Time, September 29, 1953, at the Fort Peck Indian Agency, Poplar, Montana. Those individuals desiring specific information in connection with this sale may contact Mr. James D. Crawford, Superintendent, Fort Peck Indian Agency, Poplar, Montana, or telehpone Poplar 2181.

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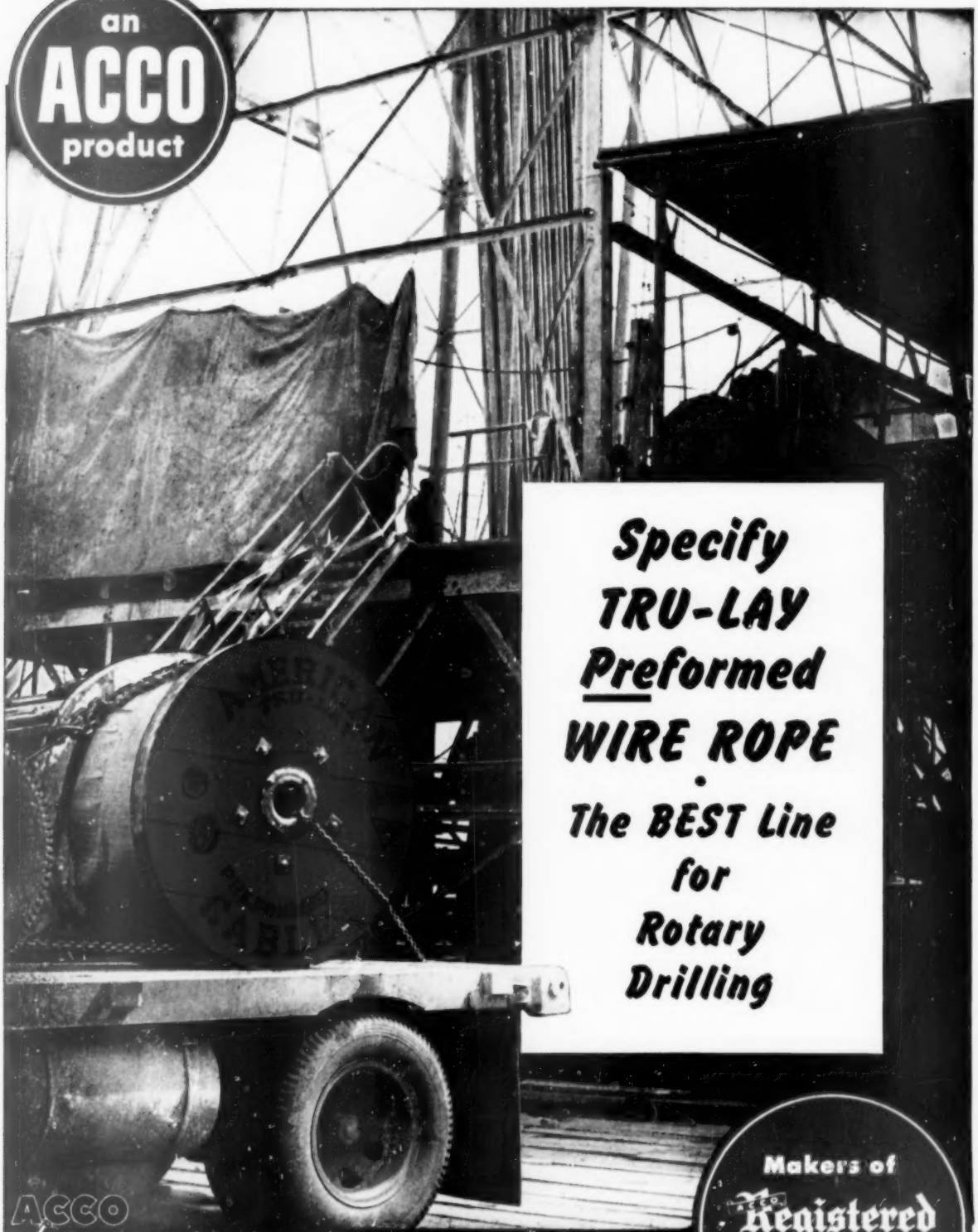

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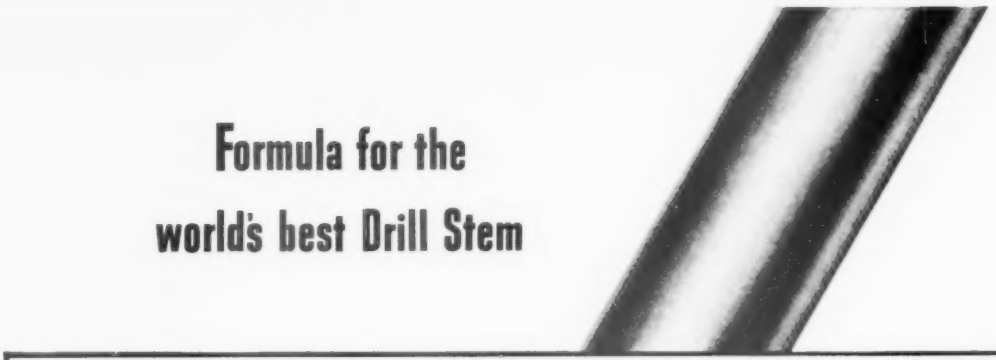

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